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ABSTRACT

We study a fundamental institution in many societies: the structure of property rights over land. Across societies, communal land rights have been more common than private land rights. We test the hypothesis that longer fallow requirements – the time needed to leave land uncultivated to restore fertility based on ecological features of the soil and climate – led to a higher prevalence of communal property rights. Longer fallow requirements generate higher protection costs and therefore make communal rights more beneficial. We construct an ecological measure of the optimal fallow length for the most suitable staple crop across grid cells globally based on soil type, temperature, and climate. We find that places where land needs to be fallowed for longer periods are more likely to have communal property rights both historically and presently. We then examine the implications for efforts to title land. Using World Bank project ratings and academic impact evaluations, we find that land interventions are less effective and positive estimated impacts are systematically less common in settings with longer fallow requirements, suggesting a mismatch between development policy and the underlying context. Our results provide insights into the origins of property rights structures and the importance of aligning development policies with the cultural and institutional setting.

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1. Introduction

Land tenure institutions vary dramatically across the developing world: some societies rely on individual property rights, while many others organize land under communal systems where extended families or communities collectively manage allocation and monitor use.[1] These differences have long been viewed through competing lenses. A modernization perspective, influential in development policy since the mid-20th century, treats communal land rights as traditional institutions that eventually give way to Western-style individual property rights for economic development to proceed. This perspective motivated billions of dollars in land titling programs, yet these reforms routinely exhibit limited take-up and disappointing impacts (Platteau 1996; Easterly 2007; Shipton 2009; Galiani and Schargrodsky 2011; Vendryes 2014). An alternative view instead emphasizes that property rights institutions emerge endogenously in response to their economic and ecological environments, particularly the costs of monitoring and enforcement (Demsetz 1967; Ostrom 1990; Cole and Ostrom 2012). From this view, communal tenure may arise and persist not despite development but because it addresses specific coordination problems, such as protecting land when state enforcement capacity is limited. Titling may thus underperform not because communities resist modernization, but because standard reforms may be poorly matched to their local conditions.

Protection costs are particularly salient when land lies fallow. Fallowing – leaving cultivated land temporarily idle to restore soil fertility – has been the world's most widespread soil-management practice for millennia (Young 1989). Yet fallow land presents a distinctive protection challenge: plots lie unused, often for years, inviting encroachment while generating no immediate returns. Demsetz (1967) noted that where fallow periods are long, the cost of individually policing idle land becomes prohibitive, making communal arrangements the more efficient adaptation to ecological constraints. Yet systematic empirical evidence for this perspective has remained elusive, as realized fallowing is endogenous to existing institutions (Goldstein and Udry 2008), and omitted factors may jointly shape both fallow practices and property-rights regimes.

In this paper, we bring new evidence to this classic hypothesis by leveraging exogenous variation in ecologically-determined fallow requirements to show that fallowing needs shape land tenure institutions. The length of time land should optimally remain fallow varies considerably across the globe as a function of soil types, climate, and crops. Using FAO crop models, we construct an ecological measure of the optimal fallow length for the maximum caloric-suitability crop (as defined by Galor and Ozak 2016) across $5' \times 5'$ grid cells worldwide under low-input assumptions. Our measure captures the share of time during the fallow–cropping cycle that land should be left idle. For example, a fallow requirement of 75% implies that if land is cultivated for 5 years, it should be left fallow for 15 years. Because this measure is determined by ecological factors rather than by farmers' choices or the institutional environment, it provides plausibly exogenous variation for testing whether the costs of protecting idle land shaped the emergence of communal versus individual property rights.

[1] In most communal land settings, individuals individually cultivate their own plots. Thus, the key distinction between communal and private land rights is whether a group or an individual own and allocate land.

We combine the fallow requirement measure with ethnographic and ecological data and find strong support for the relationship between fallow lengths and the structure of land rights. A one-standard-deviation increase in ecologically-determined fallow requirements is associated with a 0.27 standard deviation increase in the communality of land rights – a relationship robust to extensive controls for agricultural productivity, disease environment, pre-colonial political centralization, and fixed effects for the maximum caloric suitable crop. We validate our fallow measure by showing it predicts both historical fallowing practices and contemporary fallowing behavior. Turning to policy implications, we analyze both World Bank land administration projects and academic evaluations of land projects, and find they are significantly less successful in environments with high fallow requirements, consistent with policy mismatch. Finally, we explore mechanisms through which communal rights may support welfare in high-fallow settings. We document that longer fallow requirements are associated with lower inequality, reduced conflict – particularly where state capacity is weak – and greater resilience to negative rainfall shocks. Our results suggest that communal tenure persists not simply as a feature of less development but as an adaptation to ecological constraints, with important implications for when and where development policies promoting individual land rights are likely to succeed.

We first develop a conceptual framework to guide the empirical analysis and clarify how the fallow requirement affects the structure of property rights. In our model, longer fallow raises the cost of protecting land because plots are unused for extended periods. In the absence of a strong state, land can be protected individually or jointly by a community. A key assumption in the model is that there are returns to scale in the provision of protection if done as a community. The model's central prediction is that when the fallow requirement is sufficiently long, communal property rights – in which communities jointly own and manage land – will be preferred to private property rights – in which individuals or families have exclusive rights to land.

We then turn to testing the predictions of the framework. We take several steps to validate the FAO fallow requirement measure. First, we test whether the fallow requirement measure predicts historical fallowing practices using a variable from the Standard Cross-Cultural Sample (SCCS), a data set that captures historical ethnic-group level practices (Murdock and White 1969). We find that the fallow requirement predicts historical fallowing practices; longer fallow requirements are significantly correlated with having more land under fallow historically. Second, we turn to present day plot-level data for 9,500 households across 11 countries in sub-Saharan Africa (Waha et al. 2016). While limited to sub-Saharan Africa, the benefit of these data is that they provide detailed information on the fallowing status of plots in the household. We find that the fallow requirement measure is predictive of present day fallowing practices in this sample as well.

We then use the fallow requirement measure to explore how the required length of fallow is related to the type of property rights regimes across societies, historically and today. The SCCS data has a variable on the structure of property rights over land, classifying land as predominantly privately owned, partially communal, or communal rights only. This variable is available for 98 societies in the SCCS. We extend the number of groups for which this variable is available by leveraging the electronic Human Relations Area Files (eHRAF) database (Ember 2012), which is an online repository of subject-indexed ethnographic records. The database includes data on groups represented in both the SCCS and the Ethnographic Atlas (Murdock 1967). We are able to classify the structure of property rights over land for an additional 228 groups, for a total of 316 groups.

Using the original SCCS sample and our augmented sample, we turn to analyzing the relationship between the fallow requirement and the structure of property rights over land. Consistent with Demsetz, we find that communal land rights were more common in places with longer fallow requirements. A one standard deviation increase in the fallow requirement is associated with a 0.27 standard deviation increase in the communality of land rights in the original SCCS sample and a 0.19 standard deviation increase in the augmented sample. To address concerns about omitted variables, we sequentially add geographic and ethnographic controls, such as suitability for agriculture, disease suitability, fixed effects for the maximum caloric-suitability crop, pre-colonial state centralization, and settlement density. These controls help address concerns that our results are driven by the overall productivity of agriculture, which crop an area is most suitable for, or differences in political organization. We find that the estimated effect of the fallow requirement on the structure of property rights remains stable with the inclusion of these controls.

We next study contemporary land tenure arrangements. Using newly compiled global data from LandMark (2025), a geospatial inventory of lands held or claimed collectively by local communities and Indigenous peoples, we find that groups whose agro-ecological conditions historically required longer fallow are significantly more likely to hold land under communal tenure today, even after conditioning on historical covariates, contemporary controls, and country fixed effects. We further corroborate these patterns within Africa using microdata from Afrobarometer (Afrobarometer 2019), which asks about the role of traditional leaders in land allocation, a common feature of communal land rights. Consistent with both the LandMark evidence and our historical SCCS results, traditional leaders are more likely to have a role in the allocation of land in places with longer fallow requirements. Finally, we leverage micro-data from 302 villages in rural Congo. Even within a country, we find that the fallow requirement predicts fallowing practices, whether individuals have land titles, as well as local leaders' participation in the management of land.

Thus far our results suggest that longer fallow requirements led to a greater likelihood of communal land tenure, providing novel evidence on the emergence of land rights. We next examine how longer fallowing requirements affect land policy success, given the relatively lackluster success of titling reforms in some settings. Easterly (2007) posited that land titling reforms are unsuccessful because they ignore underlying property rights norms that are often communal rather than private. To explore this hypothesis, we first use World Bank project data from AidData (2017) that provide information on development projects that have been implemented, the type of project (e.g. health, governance, etc.), and ratings of how successful the project was. We estimate the reduced form effect of the fallow requirement on project outcomes for what the World Bank identifies as land administration projects – projects involving land titling, registration, land records, and property rights (World Bank Independent Evaluation Group 2016). We find that land titling projects are significantly less successful in places with longer fallow requirements, consistent with a mismatch between communal property rights and efforts to individualize land ownership. This negative effect is specific to land titling projects, and not more general to projects in other domains. These results suggest that when there is a mismatch between underlying institutions and development policies, the policies may be less successful.

We test whether this mismatch pattern extends beyond World Bank project ratings by turning to the academic evaluation literature. Using the systematic review of Tseng et al. (2021), which codes the sign of estimated effects from 117 evaluations of land tenure reforms across 42 countries, we find that positive estimated impacts of land tenure reforms are significantly less common in settings with longer fallow requirements, while unidentified (null) and negative findings are more prevalent. That the same pattern emerges independently in both World Bank administrative ratings and peer-reviewed impact evaluations suggests it is driven by a fundamental misalignment between land reforms and underlying institutional conditions — not by idiosyncrasies in how any single donor designs or implements projects.

We also examine mechanisms that may explain the persistence of communal property rights. Our conceptual framework generates two additional predictions. First, communal property may reduce inequality. In the model, this is because individuals vary in how costly it is for them to protect their land; those with a high cost of provision of security may free ride on the security provision of others in the communal regime, which is in effect a form of redistribution. More broadly, as described by Goldstein and Udry (2008), communal land may be more flexible than private land ownership and allow for reallocation to those in need. Second, communal property rights may lead to a reduction in conflict, either through their effects on redistribution or because overall provision of protection is higher in the communal regime. Therefore, we test whether longer fallow requirements are associated with a reduction in inequality and conflict.

To examine the effect of fallow lengths on inequality, we use data from the IPUMS Demographic and Health Surveys (DHS) for 47 countries in Africa, Asia, and Latin America (Boyle et al. 2022). We find that longer fallow requirements are associated with less wealth inequality, particularly in settings with low state capacity. However, we do not find a robust relationship between longer fallow requirements and wealth levels in the DHS, nor do we find that the fallow requirement is associated with a reduction in night light density, an alternative proxy for wealth levels. These results are consistent with our model's predictions that communal land rights may reduce inequality.

Using ACLED conflict data (Raleigh et al. 2010), we find that conflict is lower in places with longer fallowing requirements. This is the case for all conflict events and for conflict events identified as land-related. The negative relationship is particularly strong in settings with low state capacity. This suggests that communal land rights may be better able to reduce conflict in settings where states are weak and ineffective at enforcing private land rights (Platteau 2006; Levi and Russell 2025).

Finally, we ask whether communal property rights may also increase resilience to negative rainfall shocks. Communal land rights may reduce the incidence of conflict in the wake of negative rainfall shocks. This is because they may allow communities to more flexibly redistribute resources in the face of negative shocks (Goldstein and Udry 2008). To examine this hypothesis we leverage time variation in conflicts and rainfall shocks across the world. We construct .5 $\times$

.5 degree grid cells for the world. For each grid cell for each year, we measure conflict using data from UCDP and ACLED. We find that in years with a negative rainfall shock there are more land-related conflicts and non-state conflicts. However, this effect is muted in places with longer fallow requirements.[2]

Our findings contribute to several strands of literature. First, our paper helps bridge the economics and economic-anthropology literatures on land rights and titling reforms. A rich tradition in economic anthropology emphasizes that communal land tenure systems can function as coherent institutional responses to local risks, and that the mixed record of titling reforms often reflects a lack of contextual fit. For instance, analyzing the failure of formal titling programs across Africa, Ensminger (1997) argues that imposed property rights are often poorly matched to the informal institutions within which farmers actually operate, and that "contextual fit" between formal and informal institutions "is key" to the success of formal institutions. Communal land rights, rather than being inherently inefficient, can provide insurance, flexible reallocation, and group-based enforcement that individual titles may not deliver as effectively – mechanisms closely related to those in our model. This literature has long stressed that property-rights institutions are endogenous to their ecological and social environments, and that titling reforms that ignore this risk being mismatched to local conditions (Ensminger 1997; Shipton 2009; Li 2014). Our contribution is to move from primarily case-based evidence to systematic global evidence, showing that a single ecologically determined variable, the optimal fallow length, predicts the communality of land rights across hundreds of societies historically and today, and that land administration projects are measurably less successful precisely where communal tenure is an ecologically rational adaptation.

In this way, we contribute to the literature exploring the origins and evolution of property rights over land (e.g. Boserup 1965; Demsetz 1967; Bowles and Choi 2019; Baker and Conning 2023; Depetris-Chauvin and Özak 2024). Much of this work has focused on the emergence of private property rights where the counterfactual is unregulated open-access resources (e.g. Demsetz 1967; Alchian and Demsetz 1973). Yet communal property rights are often the more relevant counterfactual (Ostrom 1990; Baland and Platteau 1996), and there is limited systematic causal evidence on what drives variation in the structure of land rights. We provide novel causal evidence that the ecologically determined fallow requirement shaped the emergence of communal versus individual property rights across hundreds of societies globally. We also contribute to work that increasingly leverages ethnographies (e.g., Michalopoulos and Xue 2021; Michalopoulos 2025) by coding novel data on the structure of property rights for all groups in the EA for which there is sufficient data in eHRAF.

Our approach builds directly on the pioneering work by Goldstein and Udry (2008), who provide micro-evidence from Ghana that the risk of losing idle plots limits farmers' willingness to leave land fallow, making fallowing itself an investment outcome of local power hierarchies in a communal land rights system. Their findings reveal a fundamental identification challenge:

[2]For example, when rain is 50% lower in a year relative to the 5-year average, moving from a fallow requirement of 50% to 70% reduces the increase in land conflicts to near zero, effectively eliminating the conflict-inducing effect of the rainfall shock.

realized fallowing behavior is endogenous to existing institutions, making it difficult to use observed fallowing practices to study how fallow needs shape those institutions in the first place. Our paper addresses this challenge by constructing the fallow requirement measure from exogenous ecological variables – soil types, climate, and crop growth cycles – rather than from observed behavior. We thus move from the choice to fallow as an outcome of tenure insecurity to fallow requirements as a driver of the underlying structure of property rights across the world.

Our results also speak to the literature on how differences in property rights over land influence economic development (e.g. Galiani and Schargrodsky 2011). One challenge in quantifying the effects of private property rights is that it is difficult to disentangle whether the differences in outcomes arise from differences in the organization of property rights (e.g. communal vs. private ownership) or differences in the security of rights. Studies have found strong evidence that the security of property rights is essential (e.g. Besley 1995; Acemoglu and Johnson 2005; Goldstein and Udry 2008; Hornbeck 2010; Fenske 2011; Deininger et al. 2011; Raz 2018; Goldstein et al. 2018; Dyer 2023; Jordán and Heilmayr 2024; Noack and Costello 2024). However, as noted by Platteau (2000), communal land rights may offer higher security in many settings relative to private land rights, particularly in places with low state capacity or deeply embedded communal norms (Ostrom 1990; Ensminger 1997; Honig 2022; Levi and Russell 2025; Bozcaga et al. 2025). The endogenous formation of land rights has meant that there are few causal studies on how the organization of land rights matters. We provide evidence that fallow requirements led to more communal land rights relative to private land rights, and that this difference has implications for comparative development.

More broadly, our results demonstrate how underlying institutions and cultural norms regarding land rights are important determinants of the success of land policies (Deininger and Feder 2009). These findings contribute to a growing body of work highlighting the need to tailor development policies to the local institutions and cultural norms (Alsan et al. 2019; Ashraf et al. 2020; Lowes and Montero 2021; Bau 2021; Bau et al. Forthcoming). In particular, the way property rights over land are understood and how people view their relationship to land may be quite different across W.E.I.R.D. and non-W.E.I.R.D. societies (Henrich 2020; Feir et al. 2023). Our results highlight the potential for mismatch between development policies and the underlying institutional and cultural context (Nunn 2022).

These results also speak to a growing methodological opportunity in development economics. As the stock of impact evaluations of development interventions accumulates, it becomes possible to ask not only whether an intervention works on average, but whether its effectiveness varies systematically with the institutional or ecological context into which it is introduced. We take a step in this direction by using a dataset of 117 academic evaluations of land tenure reforms across 42 countries (Tseng et al. 2021). We find that the sign of estimated impacts of land tenure reforms varies systematically with fallow requirements: positive effects are significantly less likely in environments with longer fallow requirements, while negative and statistically indistinguishable or inconclusive effects are more prevalent. More broadly, this suggests that contextual heterogeneity — rooted in deep ecological and institutional conditions — may be an important determinant of policy effectiveness, and that leveraging the accumulated stock of evaluation evidence to study such heterogeneity is a promising direction for future research.

Finally, our paper contributes to a growing literature studying how ecological and environmental forces shape culture and institutions (e.g. Alesina et al. 2013; Fenske 2013, 2014a; Alsan 2015; Galor and Ozak 2016; Becker 2024; Giuliano and Nunn 2020; Raz 2020; Buggle and Durante 2021; Fouka and Schläpfer 2020; Mayshar et al. 2022; Fiszbein et al. 2022; Allen et al. 2023; Le Rossignol and Lowes 2024; Koyama et al. 2023; Becker 2024; Cao et al. 2025). Several of these papers have focused on how ecological factors influence culture and institutions through their effects on the pre-industrial agricultural practices of societies (see e.g. Alesina et al. 2013; Alsan 2015; Galor and Ozak 2016; Mayshar et al. 2017, 2022). We contribute to this literature by focusing on an understudied but prevalent economic institution – communal property rights over land – and show that historical ecological differences in fallow requirements influence land institutions and development policies.

The rest of this paper is organized as follows. Section 2 provides background on fallow practices, land rights, and the conceptual framework describing our main hypothesis that longer fallow requirements increase the prevalence of communal land rights. Section 3 describes the ecological and ethnographic data we use to test our hypotheses. Section 4 presents our empirical strategy and main results. Section 5 examines the implications of our results for World Bank policy success. Section 6 explores the mechanisms and additional implications. Section 7 concludes.

2. Background and Conceptual Framework

2.1. *Fallow Land*

The agricultural practice of fallowing land involves allowing land that is usually cultivated to lie idle for periods of time, often for many years, in order to let it recover its fertility. Fallowing is the oldest and most widespread agro-forestry practice for restoring land fertility lost in cultivation (Young 1989). The fallow period replenishes nutrients in the land by allowing other natural vegetation to grow.[3] The length of the necessary fallow period depends on soil types, climate conditions, the inputs applied, and the types of crops cultivated (Fischer et al. 2012).[4] Fallow periods that are shorter than optimal (given local conditions, inputs, and crop choice) lead to low soil fertility and low productivity. Additionally, fallow periods that are too short lead to soil erosion as crops do not develop sufficiently strong root systems to protect against flooding and sliding. Rotating between crop cultivation and fallowing, also known as shifting cultivation, remains a common practice in many countries in sub-Saharan Africa and Latin America to restore soil fertility and limit soil degradation (López 1998).

Allowing land to fallow is key to restoring land fertility, but it is a complex decision for agricultural producers. Letting land fallow, while an investment in future productivity, is a source

[3]In more modern agricultural systems, instead of relying solely on naturally occurring vegetation during fallow periods, specific vegetation – such as grasses, a grass-legume mix, or a green-manure crop rotation – are used to further enhance soil fertility during fallow periods (Fischer et al. 2012).

[4]Eventually, all land should be left fallow after a given period of cultivation (Fischer et al. 2012).

of potential insecurity for two reasons. First, by letting land fallow instead of cultivating it, individuals may face consumption insecurity in the absence of social insurance or if they lack access to sufficient non-fallow land (De Zeeuw 1997; López 1998). Second, in settings with weak state capacity, fallow land may be subject to expropriation by outsiders or other villagers. The investment and insecurity aspects of the fallowing decision may interact: more security may increase the extent of fallowing, yet fallowing itself may lead to less security (e.g. Goldstein and Udry 2008). For these reasons, rather than letting fallow land remain completely unregulated and open to outsiders (i.e. open-access), villages often defined property rights over fallow land.

2.2. *Property Rights over Land*

Property rights over land are a bundle of rights related to the use, access, and transfer of land. These rights can take various forms, but they almost always involve some regulations regarding how land can be used, if it can be transferred, and who can access it. In other words, land – including fallow land – is not open-access land; instead, groups define a set of land rights to govern and manage agricultural land (Platteau 2000).

In societies with private property rights over land, all land rights for a given plot are held by a sole individual or by a nuclear family (as a single household). In contrast, in societies without fully individual private property rights, communities manage land communally, where several or all land rights are held and granted by a community (Boserup 1965; Gavian and Fafchamps 1996; Platteau 2000; Deininger and Feder 2001). Communities in these cases are defined as a collective group of people who are either extended families, clans, villages, or members of an ethnic group (Binswanger and McIntire 1987; Platteau 2000). This form of kin-based communal land ownership was the predominant form of property rights in pre-industrial Western societies (Boserup 1965; Goody and Goody 1983).

Communal land rights can consist of more or less "communality" depending on how many components of rights (e.g. use, access, transfer) are allocated to the community. However, communal land rights tend to have the following characteristics. First, land that is owned communally by villages or lineages has restrictions on its use by outsiders (López 1998). Second, individuals often have exclusive use rights to the land that they are currently cultivating and the crops they produce on the land. However, once the land is left fallow, the land can be reallocated by the community (López 1998; Pande and Udry 2005; Goldstein and Udry 2008). Thus, conceptually, the key distinction between private and communal land rights lies in whether an individual or a group has a claim to the land, even though under both regimes individual households cultivate their own plots.

2.3. *Ethnographic Description of Land Rights*

Traditional land ownership practices are often complicated and can be difficult to categorize. To better illustrate how differences in the structure of property rights may operate in practice, we provide ethnographic examples of how different societies organized access to land. These map onto the categories presented in the SCCS – ranging from predominantly private property to exclusively communal land ownership.

Predominantly private property: The SCCS identifies the Azande (in South Sudan) as having predominantly private ownership of land. Among the Azande, who relied primarily on agriculture, the homestead and surrounding gardens and fields are held by the family (Gillies 1999; Seligman and Seligman 1932). Nominally, land belonged to the chief. However, the chief had little control over the land. Tenure rights were established by clearing and cultivating the land (Baxter and Butt 1953). As Larken (1926) writes,

> *"The occupier or cultivator of a piece of land retained his rights over it, and over all things growing on it, and on all buildings erected upon it, for as long as he liked. Even though he might have left the site for years it was still his, and he could, if anyone settled on it, claim damages up to five spears against the intruder. Only if he left the country of his Chief did he lose these rights. Thus, cultivation establishes ownership, and the land remains the property of an individual or his heirs for "as long as he or they wish"."* (Larken 1926, p.118).

In his article on land tenure among the Azande, Guttman (1956) describes in great detail the land tenure arrangements he observed during his fieldwork in Sudan. When the Azande kingdom was in existence, the King was considered the owner of all land. With the end of the kingdom, chiefs were then considered the owners of the land. For men who wished to establish homesteads, a father might help his son identify fertile land. After consulting with the oracle, the son would then set up his homestead on the land, including building a hut and cultivating the land. While the land is believed to belong to the chief, the chief's permission is not required to establish the homestead nor must he be informed. An individual cultivating land in a particular chieftaincy may periodically give presents to the chief, but these gifts are not considered payment for the land. A homestead may be abandoned in several cases, including expulsion, death, repeated illness, and repeated failure of crops. Upon a man's death, he may nominate a son to take over his homestead. Guttman concludes that there is no legal landowner-tenant relationship between chiefs and subjects. Subjects do not have obligations to the chief that are tied to the land. He notes that in this setting there is an abundance of land, and individuals tend to cultivate land until it is no longer fertile.

Thus, in short, individuals among the Azande retained control over land once it was cleared and cultivated and only relinquished that control by choice. Chiefs nominal ownership of land had little bearing on how individuals accessed or used land.

Partially communal land rights: An example of a group that had partially communal property in the SCCS is the Mapuche of Chile. Among the indigenous Mapuche in the 18th century, land was owned communally by groups of families (Nakashima Degarrod 2009). Each close kinship group claimed a particular territory that had been passed to them from their ancestors (Cooper 1946). Each family owned the land that they cultivated or that they used for grazing. This land could be transmitted to their heirs (Cooper 1946; Nakashima Degarrod 2009). However, land that was not actively cultivated or that was temporarily under fallow was communally held. Chiefs were in charge of administering land and allocating plots to families (Faron 1964; Nakashima Degarrod 2009).

In 1885 the Chilean government established reservation settlements, weakening communal land holding and strengthening individual land ownership (Nakashima Degarrod 2009). Nevertheless, chiefs continued to hold power over land. As Titiev (1951, p. xii) writes "It was the chief who held at least nominal title to his group's land, and it was he who allotted parts for the use of particular followers... [The chief's] advice was sought on all occasions, and no man of his unilocal household or its equivalent could marry without his consent." In fact, the chief's authority over marriage was linked to his control over land (Faron 1964). According to Smith (1855), only chiefs had the authority to sell land to non-community members – though sale of land to Whites was a capital crime.

In summary, the indigenous Mapuche practiced an intermediate form of communal land – in which extended kin groups owned land communally and chiefs had the ultimate authority over land. However, individuals retained control over land they were cultivating.

Communal land rights: Finally, we turn to the Ashanti (Akan) in Ghana as an example of a group coded as having fully communal property rights over land in the SCCS. The Ashanti distinguish between three aspects of land: the land itself (e.g. the soil and earth); the usufruct rights of the soil; and crops, trees, and houses which are viewed as separable from the soil. Land among the Ashanti is believed to belong to the ancestors (*samanfo*), and the living are believed to be tenants of the dead and trustees of the land on behalf of the ancestors (Rattray 1923; Manoukian 1950; Warren 1986).

Land is held in common by the people, and the chief is the custodian of the land. The chief must guard the land in the interest of the community, ensuring the fair distribution and proper utilization of the land (Danquah 1928; Manoukian 1950). Manoukian (1950, p.47) describes the relationship between the land, the Stool (a symbol of political power), the Chief, and the people: "The land is a link between the ancestors and their living descendants. The Stool symbolizes the unity of the ancestors and their descendants and the Chief occupies the Stool; 'the land belongs to the Stool' or 'the land belongs to the Chief' both mean the same thing: 'the land belongs to the ancestors"'. Land was considered an unalienable possession of the clan (Gilbert et al. 2000). In fact, until recently, according to Warren (1986, p.55), "the process of alienation known as "sale" was altogether absent in the Ashanti code of land laws... Even the *Asantehene's* (paramount chief's) right to a subject's property applied only to personal or individual property, and never land because land as such was never individually owned".

While individuals could not own land, individuals could have usufruct rights over land – in which they could build, plant trees, and sell produce (Manoukian 1950). Inheritance of the right to use land was through the matrilineage (*abusua)* (Warren 1986). Within a village, all members of a matrilineage would have the right to farm or build on land, as long as they were not trespassing on the rights of another member of the lineage. However, they were unable to alienate (sell, mortgage) the land (Manoukian 1950). Tenure security was based on continual working of the land and meeting customary obligations to the Stool. If a stranger used a tract of land and abandoned it, the land would revert back to the Stool. If a member of the community abandoned land, they could later try to reclaim the land if trees he planted were still bearing (Warren 1986).

The Ashanti provide a clear example in which individuals could not own land. Land was commonly held by the matrilineage, but belonged to the ancestors. Individuals and their families could establish rights to use plots and to pass those rights on, but these rights were contingent upon meeting obligations to the Stool and continual use of the land.

2.4. *Evolution of Land Rights*

A fundamental debate in anthropology and economics concerns the evolution and emergence of property rights structures. An influential view in economics holds that property rights emerge endogenously in response to changing benefit-cost conditions. Demsetz (1967, pg. 350) summarized this view as follows: "It is my thesis that . . . the emergence of new property rights takes place in response to the desires of interacting persons for adjustment to new benefit-cost possibilities. . . property rights develop to internalize externalities when the gains from internalization become larger than the costs of internalization."

A key implication of this framework concerns the role of protection costs. When land must lie fallow for extended periods, the cost of monitoring and defending idle plots rises – and rises in proportion to the length of the fallow period. Demsetz (1967) identified precisely this mechanism as a determinant of land property rights:

> *"Once a crop is grown by the more primitive agricultural societies, it is necessary for them to abandon the land for several years to restore productivity. Property rights in land among such people would require policing cost for several years during which no sizable output is obtained. Since to provide for sustenance these people must move to new land, a property right to be of value to them must be associated with a portable object. Among these people it is common to find property rights to the crops, which, after harvest, are portable, but not to the land. The more advanced agriculturally based primitive societies are able to remain with particular land for longer periods, and here we generally observe property rights to the land as well as to the crops."* (Demsetz 1967, p. 353)

In other words, longer fallow periods raise the cost of protecting land, making it harder to sustain individual property rights and increasing the relative attractiveness of collective arrangements.[5]

One critique of this tradition is that it implicitly assumes private land rights generate more tenure security, leading to greater investment through an assurance effect. This assumption requires a strong state or neutral third party for enforcement. In many settings this is unlikely to hold and, in fact, communal rights may provide more tenure security (Atwood 1990; Platteau 2000; Brasselle et al. 2002).[6] Platteau (2000, pg. 140) notes:

[5] Boserup (1965) made a parallel observation, noting that as fallow periods shorten under population pressure, individual families become more attached to specific plots and chiefs' redistributive role gradually disappears. While her emphasis is on population-driven intensification rather than the protection cost channel we formalize, the predicted relationship between fallow length and communality of land rights is the same.

[6] Additional critiques are that this tradition ignores cultural practices communities develop to manage communal resources (e.g. Ostrom 1990), abstracts from the direct costs of privatization (Baland and Platteau 1998), and often ignores the distributive consequences of privatization (Platteau 2000).

"as is apparent from the ... survey of the African situation, there is no solid basis for claiming that increased individualization of land rights generates an assurance effect. As it turns out, in customary land areas basic use rights seem to be sufficient to induce landholders to invest and the adding of transfer rights (with the possible exception of the right to bequeath land) does not appear to significantly improve investment incentives."

We build on these insights and test the hypothesis that a longer fallow requirement – by raising the cost of protecting idle land – makes it more likely that a society will develop communal land rights. The key mechanism, as Demsetz (1967) identified, is protection cost: where fallow periods are long and state capacity weak, individual monitoring becomes prohibitively costly relative to collective arrangements. We develop this intuition formally in the conceptual framework below.

2.5. *Conceptual Framework*

We develop a model to sharpen the intuition for how the ecologically determined length of fallow shapes the structure of property rights, building on the insights of Demsetz (1967). The details of the model are outlined in Appendix B.[7] The intuition of the model is as follows. A longer length of fallow increases the cost of protecting land. While the fallow requirement can be interpreted as the number of years that the land should be left fallow after a given period of cultivation, the fallow requirement can also be interpreted as the share of land under fallow at any given time. Thus, a longer fallow requirement means more land must be protected from outsiders squatting on or cultivating the land.

Land can be protected individually in a private property rights regime or as a community in a communal property rights regime. It is costly for individuals to protect land, and individuals vary in how costly it is for them to protect the land. However, for all individuals the cost of protection is increasing in the length of fallow. Under both private property and communal property, individuals choose whether to pay the monitoring cost to protect the land. When individuals pay the monitoring cost, they are successful at protecting their land.

A key assumption of the model is that there are returns to scale in the protection of land if done jointly as a community. If enough individuals cooperate to protect the land, then the cost of protection falls. However, individuals can free-ride in the communal regime. Thus, to enforce cooperation in the provision of protection, individuals who free-ride can be excluded from the community land in the future. In both regimes, if individuals do not pay the monitoring cost, there is some chance that their land can be expropriated.

Payoffs are determined by: the property rights regime, whether an individual chooses to pay the monitoring costs to protect land, the length of fallow, and whether an outsider tries to squat on or expropriate the land. In the private property regime, if an individual chooses to pay the monitoring cost, the payout is a function of benefits from cultivation, the individual cost of providing protection, and the length of fallow. If the individual chooses not to pay the monitoring

[7] Our framework builds on canonical models of how costly defense and monitoring shape land governance. For defense-driven shifts from open access - rather than communal - to individual tenure see Baker (2003); for monitoring-driven shifts to communal rights due to theft under rising prices - rather than higher land protection costs - see Fenske (2014b).

Table 1: Summary of Conceptual Framework Predictions

	Prediction:	*Empirics:*
Main prediction:		
↑ Fallow requirement	↑ Communal land rights	↑ Prevalence of communal land rights
Secondary predictions:		
↑ Fallow requirement	↓ Interest in private rights	↓ Success of World Bank land titling projects
	↓ Inequality & unrest	↓ Income inequality & conflict events

cost, then their payout is a function of the benefits from cultivation and the probability that the land is expropriated by outsiders, which reduces their payout.

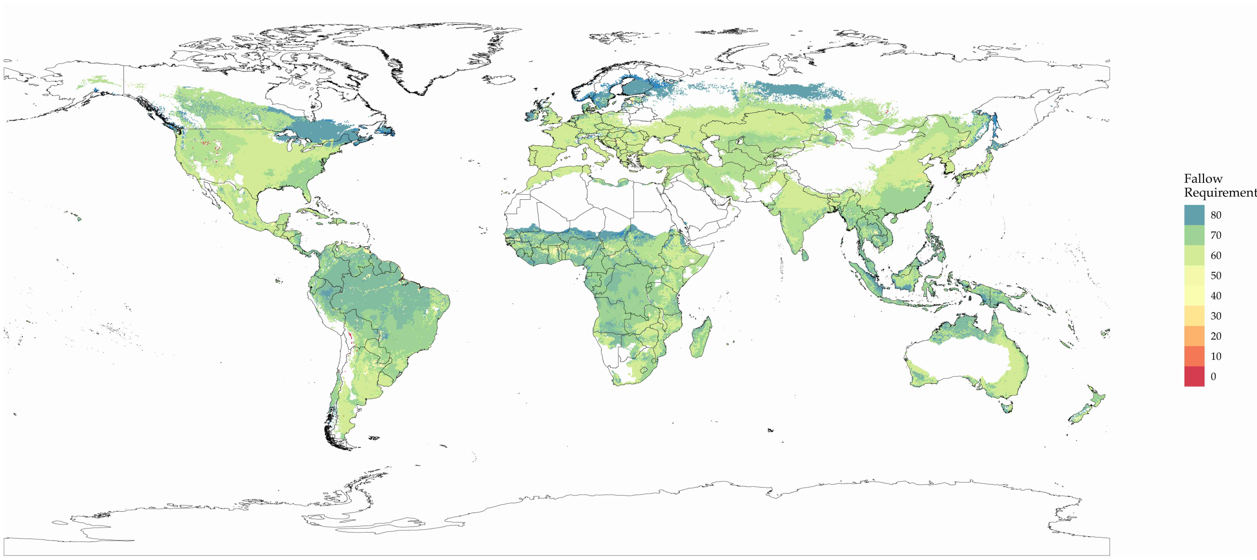
In the communal regime, for an individual who pays the monitoring cost, their payoff is a function of the benefits from cultivation, the individual cost of monitoring, the length of fallow, the share of other individuals who choose to pay the protection cost, and a fixed cost of organizing to provide communal protection. If enough individuals participate in the communal protection of land, then the cost of protection falls. If an individual chooses not to pay the protection cost, their payout is a function of the benefits from cultivation, the probability that the land is expropriated, the share of other individuals who choose to pay the protection cost, and a fixed cost of organizing to provide communal protection.

The key insights are as follows. First, the expected payoff in both the private regime and the communal regime is decreasing in the length of fallow (see Appendix Figure B1). Second, given the advantages of group protection, above a certain threshold length of fallow, the communal regime is preferred over the private regime as the returns to scale in protection become more valuable (see Appendix Figure B2).

In addition, the model has several other implications. The communal regime reduces inequality. This is because individuals that have high protection costs and that choose to free-ride can still benefit in the communal regime from group protection. In effect, this provides redistribution across members in the communal regime. Additionally, communal land rights may reduce conflict. This is through two channels. First, the redistribution channel described above may lead to a reduction in unrest. Second, all else equal, more protection is provided under the communal regime, reducing conflict. We summarize the set of predictions in Table 1.

Note that our framework abstracts from many important aspects. In particular, the framework assumes that state enforcement of land rights is missing. This stands in contrast to some modern settings where states are effective at arbitrating disputes and enforcing private land rights. Communal land rights may be particularly beneficial when the state is unable to enforce private property rights. Additionally, the framework ignores elite capture, either in state enforcement (Behrer et al. 2021) or in land allocation under communal land rights (Goldstein and Udry 2008).

Figure 1: Fallow Requirements Across the World



Notes: The map presents the fallow requirement for the maximum caloric-suitability crop for each 5′ × 5′ grid cell. The fallow requirement for a crop is defined as the optimal percentage of time during the fallow-cropping cycle that land should be under fallow (Fischer et al. 2012). Cells shaded in white represent regions where the land is not suitable for agriculture.

3. Data Sources

3.1. *Fallow Requirement*

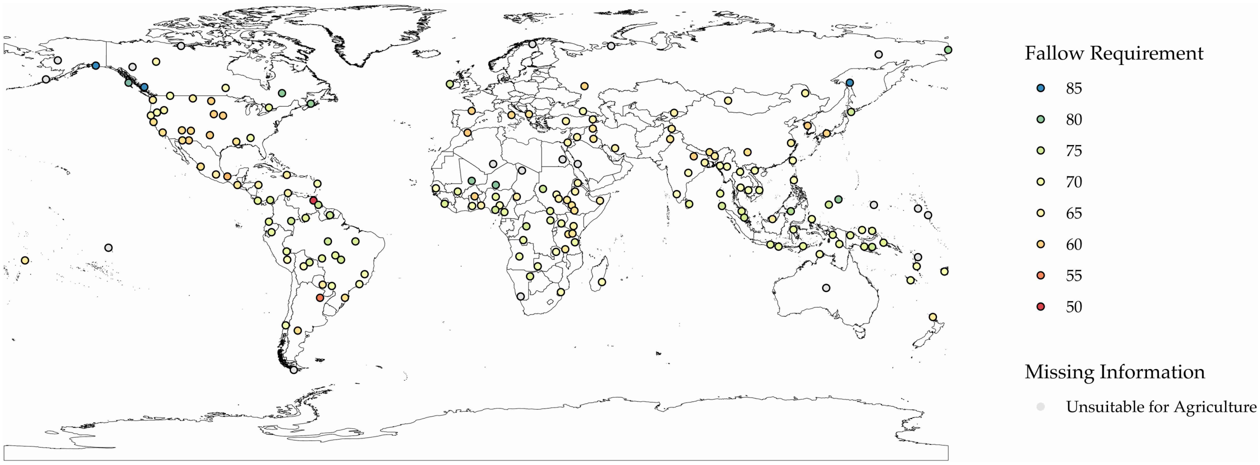
We use FAO GAEZ data and models to construct the extent to which crops in a particular location require fallowing. The FAO estimates fallow requirements for various crop types as a non-linear function of: local soil type, inputs, temperature, crop growth cycles, and climate (Fischer et al. 2012). The FAO models express fallow requirements as the percentage of time during the fallow-cropping cycle the land must be under fallow. For instance, a fallow requirement of 50% means that after three years of cultivation, the land needs to remain fallow for three years; likewise, a fallow requirement of 70% implies that after three years of cultivation, the land needs to remain fallow for seven years.[8] We calculate the fallow requirement for rain-fed agricultural production with low input levels.[9] Using the FAO models, we construct the fallow requirement for the maximum caloric-suitability crop (as defined by data from Galor and Ozak 2016) for 5′ × 5′ grid cells across the world (approximately 100 km^2).[10] Note, this fallow requirement measure is not contingent on actual crop production choices – but rather reflects the optimal fallow length for the maximum caloric suitable crop, regardless of whether that crop is actually produced. Figure 1 presents a map of fallow requirements across the world. In Appendix A.3, we present the geographic and ethnographic correlates of the fallow requirement.

[8] The fallow requirements developed by Fischer et al. (2012) were based on previous work estimating fallow periods across different regions (e.g. Young and Wright 1980; FAO/IIASA 1991).

[9] For intermediate level of inputs, the FAO sets fallow requirements at one third of the fallow period requirement under low input levels. For high input levels, the FAO sets fallow requirements uniformly at 10% (Fischer et al. 2012).

[10] See Figure A.1 in Galor and Ozak (2016) for a map of the maximum caloric-suitability crop across the globe for 5′ × 5′ grid cells.

Figure 2: Fallow Requirements Across SCCS Societies



Notes: The map presents the fallow requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric-suitability crop for each group in the SCCS. Grey dots represent groups where the land is not suitable for agriculture.

3.2. *Ethnographic Data*

We use ethnographic data from the Standard Cross-Cultural Sample (SCCS) (Murdock and White 1969) for information on societies' agricultural practices historically. This data source contains detailed ethnographic questions for 186 cultures. The SCCS societies were chosen from the full sample of societies in the Ethnographic Atlas (EA), which provides ethnographic data on 1,265 societies (Murdock 1967); this sample was chosen to be representative of the full EA sample and to be culturally and historically independent from other societies sampled.[11] While the EA covers a larger set of societies than the SCCS, the EA does not contain a variable on the structure of property rights over land.[12]

For the ethnographic data in the SCCS, information on each society is coded for the earliest possible period that contains satisfactory ethnographic data.[13] This information has been coded to attempt to reflect conditions prior to industrialization and (where applicable) prior to European contact. The data include longitude and latitude measures for the centroid of a society's historical location. Figure 2 presents a map with the centroids of SCCS societies and the estimated fallow requirement for a 100 km buffer around these centroids.

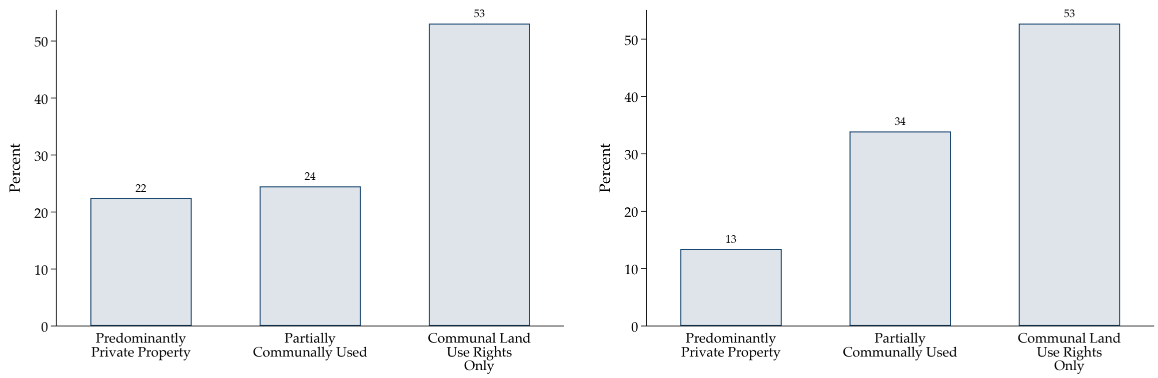
To examine whether a society in the SCCS has communal land rights or private land rights, we use variable 1726 denoted as measuring the "Communality of Land" (Murdock and White 1969). This is a 1 to 3 categorical variable, where 1 = land is predominantly private property, 2 = land is partially communally used, and 3 = communal land use rights only. Given that the SCCS

[11] To select societies for the SCCS, they first grouped the 1,265 societies from the EA into 186 clusters of closely-related cultures, and then one representative and well-documented society was chosen from each cluster to be part of the SCCS (Murdock and White 1969).

[12] The most closely related variable in the EA is v74, *Inheritance Rule for Real Property (Land)*. However, this does not map cleanly onto the structure of property rights – but rather how land rights and access are transmitted. The response options are: absence of individual property rights or rules; matrilineal (sister's sons); other matrilineal heirs (e.g. younger brothers); children, with daughters receiving less; children, equally for both sexes; other patrilineal heirs (e.g. younger brothers); patrilineal (sons).

[13] For societies with a written history, the dates of this written history are the observation dates. For groups without written histories, the dates of observation refer to the dates of earliest observation of these cultures by ethnographers.

Figure 3: Communality of Land Across Societies



a. SCCS Sample

b. Augmented Sample

Notes: The Figure presents a histogram for the "Communality of Land" variable (v1726) for (a) 98 societies in the SCCS and (b) 316 societies in the augmented sample combining EA and SCCS societies (b). The numbers above each bar represent the share of societies with that structure of property right over land.

only defines the land rights variable for 98 societies, we extend the coding using ethnographic records that are present in electronic Human Relations Area Files (eHRAF) database (Ember 2012). eHRAF is an online repository of subject-indexed ethnographic records covering groups that are present in the SCCS and the EA. We search for ethnographic records that have been identified as covering subjects related to property rights and land. Research assistants independently review the records related to property rights and land and based on the whole of the ethnographic record present in eHRAF, classify groups as private, partially communal, or communal land rights only – following the original classification of the SCCS. These independent codes are then rectified to produce one final classification with a summary of the corresponding evidence from eHRAF. Following this methodology, we are able to codify the structure of property rights for an additional 228 groups, for a total of 316 societies. We refer to this larger sample with the newly coded societies as the augmented sample. For additional details on the coding process, refer to Appendix A.2.

Figure 3 presents the distribution for the "Communality of Land" variable for the original SCCS sample (a) and the augmented sample (b). In both samples, we find that communal land rights were much more common than private land rights. In the original SCCS sample, 53.06% of societies had communal land rights only, 24.49% had partially communal land rights, and 22.45% had predominantly private property rights. In the augmented sample, 53% had communal land rights only, 34% had partial communal land rights, and only 13% had predominantly private property.[14]

To validate that our measure of fallowing requirements correlates with the historical amount of fallow land in a society, we use variable 1128 from the SCCS, labeled as the "Cropping Index (Rough indicator of Fallowing) for Major Crops" (Murdock and White 1969). This variable measures the "percentage of total land used for major crops in any given year," where land that

[14] Appendix Figures A1 and A2 present maps of the communality of land measure across the original SCCS sample and the augmented sample, respectively. Communal land rights are particularly prevalent in South America, sub-Saharan Africa, and parts of Asia.

is not used is presumed to be fallow land (Pryor 1986).[15] For societies that practiced agricultural production, the variable is a 1 to 5 categorical variable, where 1 = less than 10% of land used per year, 2 = 10% - 29% of land used per year, 3 = 30% - 49% of land used per year, 4 = 50% - 99% of land used per year, and 5 = 100% or more of land used per year.[16]

3.3. *Ethnologue to Link Ethnographic Data to Modern Data*

For analyses involving contemporary outcomes, we construct measures of the fallow requirements at the ethnologue group or country level using the data and methodology developed by Alesina et al. (2013) and Giuliano and Nunn (2018). The ethnologue-level and country-level measures correspond to the average fallowing requirement faced by the ancestors of individuals currently living in an ethnologue group or country. To create this measure, we use data from Giuliano and Nunn (2018) on (i) the location of ethnic groups using over 7,000 different languages or dialects from Ethnologue 16 linked to societies in the EA, and (ii) information on global population densities (at a one-kilometer resolution) from the Landscan database. By using the link between the EA societies and each of the 7,000+ Ethnologue dialects, we create a measure of the ancestral fallow requirements for all individuals living in an ethnologue group or country today.[17]

3.4. *Contemporary Data Sources*

We use several contemporary data sources. To measure communal land tenure today, we use the global LandMark platform (LandMark 2025), a geospatial inventory of lands held or claimed collectively by local communities and Indigenous peoples (whether or not these rights are formally recognized by the state). Using the Ethnologue territories described above, we overlay LandMark polygons with ethnolinguistic territories to construct, for each ethnolinguistic group (language–country), the share of its territory that overlaps LandMark communal-land polygons. A key advantage of LandMark for our purposes is that it provides a genuinely global inventory of collectively held lands, compiled from national and subnational mapping efforts under a common typology.[18]

We also draw on several additional contemporary datasets for specific analyses. First, to validate that the FAO fallow requirements serve as a proxy for contemporary fallowing choices, we use detailed data on contemporary farming practices collected from 11 sub-Saharan African countries (Waha et al. 2016). Second, to substantiate our LandMark-based measure of communal tenure within Africa, we use data from Afrobarometer Round 8 (Afrobarometer 2019), which contain information on the role of traditional leaders in land allocation. Third, we leverage micro-data from 302 villages in the DRC to ask whether similar patterns hold across villages

[15] Note, for this variable, tree crops are considered to have no fallow.

[16] The amount of land used for major crops can be over 100% due to double cropping.

[17] Figure A3 presents a map of the fallow requirement for the Ethnologue language groups linked to EA societies, and Figure A4 presents a map of the ancestry-adjusted fallow requirements across countries.

[18] For recent applications of the LandMark data, see, for example, Alden Wily (2018), Rakotonarivo et al. (2023), and Barajas et al. (2024). Figure A5 presents a map of share of land held communally across countries, and Figure A6 presents a map of the Landmark polygons that denote land held or claimed collectively by local communities.

within a single country (Lowes et al. 2024). Additionally, to study how land rights interact with development policy, we use geo-referenced World Bank project data from AidData (2017) and impact evaluation outcomes from (Tseng et al. 2021). To analyze effects on wealth and inequality, we use data from IPUMS DHS (Boyle et al. 2022). Finally, to examine effects on conflict and violence, we use two data sources: ACLED (Raleigh et al. 2010) and UCDP (Uppsala Conflict Data Program 2021). For additional information on the datasets used in the analyses, variable definitions, and maps displaying the various samples, see Appendix A.

4. Results

4.1. Empirical Strategy

We examine the relationship between the fallow requirement and our outcomes of interest (e.g. communal land rights) in the ethnographic data by estimating the following equation:

$$y_s = \gamma_1 \text{Fallow Requirement}_s + \mathbf{X}_s'^G \Gamma + \mathbf{X}_s'^E \Phi + \delta_{r(s)} + \varepsilon_s \tag{1}$$

where y_s is the outcome of interest for society s. We measure the Fallow Requirement$_s$ as the average percentage of time during the fallow-cropping cycle that land should be under fallow for the maximum caloric-suitability crop of a society s using a 100 km buffer around the society's centroid. We sequentially include $\mathbf{X}_s'^G$, a vector of geographic covariates at the society-level, and $\mathbf{X}_s'^E$, a vector of historical pre-colonial ethnographic covariates. The society-level geographic and ethnographic controls and are described in detail below. We also include continent fixed effects, $\delta_{r(s)}$ (where $r(s)$ is a function that maps societies s to continents r) to account for time-invariant differences across regions, and we estimate robust standard errors. We also report Conley standard errors to account for spatial autocorrelation. Our coefficient of interest is γ_1: the effect of the fallow requirement on our various outcomes.

We add the following sets of control variables in our analyses to address a wide-variety of potential omitted variables. For geographic covariates ($\mathbf{X}_s'^H$), we include: temperature (Fick and Hijmans 2017), precipitation (Fick and Hijmans 2017), land suitability (Ramankutty et al. 2002), longitude (Murdock and White 1969), elevation (NOAA National Geophysical Data Center 2009), and suitability for the plough (Galor and Ozak 2016). We also include disease suitability controls: tsetse fly suitability (Alsan 2015) and the malaria ecology index (Kiszewski et al. 2004). We calculate these measures using using a 100 km buffer around the society's centroid. In an additional specification, we include fixed effects for the maximum CSI-crop (Galor and Ozak 2016) to account for unobserved differences across crops. This is important given recent work on how features of crops (whether they are easily appropriable) can lead to differences in state institutions (Mayshar et al. 2022). Finally, we include the following ethnographic controls ($\mathbf{X}_s'^E$) from the SCCS: pre-colonial centralization, settlement density, and the presence of large animals (Murdock and White 1969).[19] Appendix A provides details on the data sources and variable

[19] We control for the presence of large animals because intensity of agricultural production may also be related to other forms of economic production, such as reliance on animal husbandry. Additionally, animal husbandry may affect availability of manure to use on fields – thus reducing the required fallowing length.

definitions.

When using contemporary data to examine the relationship between the fallow requirement and outcomes of interest, we modify equation (1) and estimate the following equation:

$$y_{esc} = \gamma_2 \text{Fallow Requirement}_{esc} + \mathbf{X}'^{G}_{esc}\Gamma + \mathbf{X}'^{E}_{esc}\Phi + \delta_c + \varepsilon_{esc} \tag{2}$$

where y_{esc} is the outcome of interest for ethnologue group e linked to historical society s (as in Giuliano and Nunn 2018 and Cao et al. 2025) in country c. Fallow Requirement$_{esc}$ is the average percentage of time during the fallow-cropping cycle that land must be under fallow for the maximum caloric-suitability crop for the Ethnographic Atlas group s linked to ethnologue group e. As in equation (1), we include $\mathbf{X}'^{G}_{esc}$, a vector of geographic covariates, and $\mathbf{X}'^{E}_{esc}$, a vector of historical pre-colonial ethnographic covariates. For contemporary outcomes, we also include country fixed-effects, δ_c, which absorb time-invariant differences across countries, including differences in data quality and measurement. We estimate standard errors clustered at the group s level and also report Conley standard errors to account for spatial autocorrelation. Our coefficient of interest is γ_2: the effect of ancestral fallow requirements on our various outcomes.

4.2. Validating the Fallow Requirement Measure

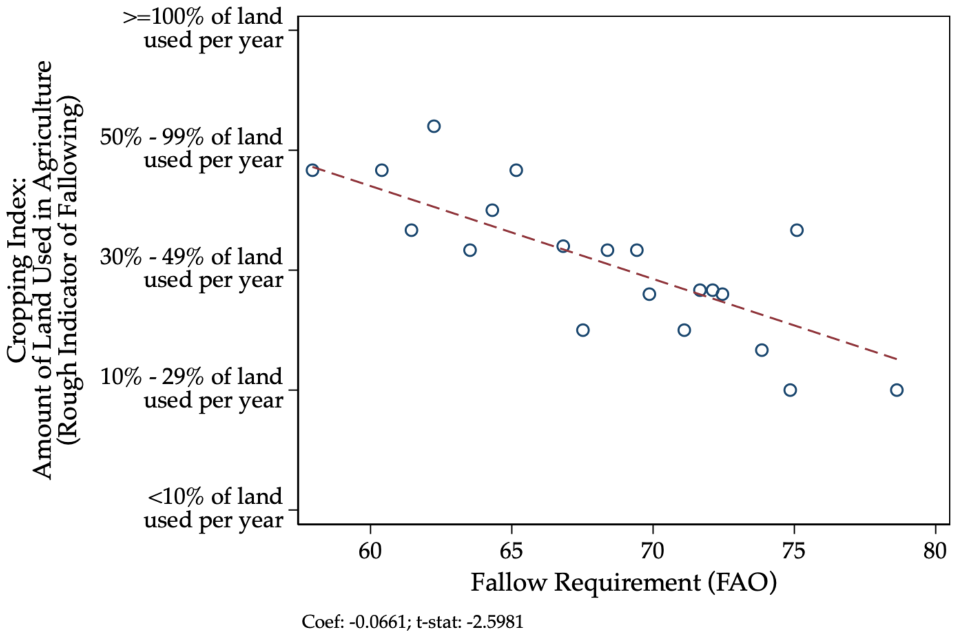
We first confirm that the FAO fallow requirement measure is correlated with observed fallowing practices across societies. We estimate equation (1) for SCCS societies where the outcome variable is the "Cropping Index" – the percentage of total land used in any given year for major crops. If our fallow requirement measure is a reasonable proxy for agricultural practices historically (and subsequent property rights), then we would expect a strong negative relationship between the fallow requirement measure and the percentage of land used for major crops in a given year.

Figure 4 presents a binscatter between a society's estimated fallow requirement and the cropping index measure. We find a negative and statistically significant relationship between a society's estimated fallow requirement and the cropping index measure, suggesting that the fallow requirement measure captures historical fallowing practices.

We further investigate the robustness of this relationship to the inclusion of geographic covariates. This addresses the concern that the relationship between the fallow requirement and the cropping index might be driven by omitted differences in geographic characteristics. Table 2 presents the estimates for equation (1), where we sequentially add a number of geographic covariates that might affect the amount of fallow land. In particular, we include continent fixed-effects (in column (2)); controls for latitude, longitude, average precipitation, average temperature, and agricultural suitability (in column (3)); controls for malaria suitability and tsetse fly suitability (in column (4)); fixed-effects for the maximum caloric crop for each society (in column (5)); and controls for the presence of large animals, settlement density, and pre-colonial centralization (in column (6)).[20] Throughout, we continue to find a negative and statistically significant relationship between fallowing requirements and the amount of agricultural land used in a given year: a

[20]All geographic and disease controls aside from latitude and longitude are calculated using a 100 km buffer around an SCCS societies centroid.

Figure 4: Fallow Requirements and Observed Fallowing Intensity: SCCS



Notes: The figure presents a binscatter between the fallow requirement and the reported share of a land used for major crops (a proxy for the amount of land that lay fallow in a given year). The unit of observation is a SCCS group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic using robust standard errors.

one standard deviation increase in fallow requirements (approximately 6 percentage points) is associated with a 0.81 unit decrease on the 1-5 agricultural land use index, roughly corresponding to a shift of nearly one full category (e.g., from using 30-49% of land per year to 10-29%).[21] We also present Conley standard errors in brackets to account for spatial auto-correlation within 100 kilometers of an SCCS centroid.

We also examine whether the fallow requirement measure predicts contemporary fallowing practices. In developed countries, the practice of fallowing has decreased over the last century due to increased access to modern inputs, such as fertilizer. Therefore, we focus on data from Africa to investigate the relationship between fallow requirements and contemporary fallowing practices. For this exercise, we rely on data from an agricultural survey of 9,500 farm households conducted in 11 African countries (Waha et al. 2016). This dataset provides information on the farming system for all the plots in each farm household. For a given plot, respondents answer a question about how the land is used. Respondents can select one of the six following forms of cultivation: (i) shifting cultivation (with long fallow period), (ii) continuous cropping (no fallow period), (iii) continuous cropping with multiple rotations (includes short fallow period), (iv) livestock grazing land, (v) other, and (vi) combination of above.

[21] Boserup (1965) noted that longer fallowing requirements would also be associated with more extensive (less intensive) agricultural production. Table C1 presents estimates for the relationship between longer FAO fallow requirements and the intensity of agriculture across societies in the SCCS. We find evidence consistent with Boserup (1965): longer FAO fallow requirements are associated with less intensive agricultural production. However, this relationship is not statistically significant once we add geographic controls. We also present the relationship between the fallow requirement and jurisdictional hierarchy in Table C2. The point estimates are small and insignificant.

Table 2: Effect of Fallow Requirement on Amount of Land Used for Agriculture in SCCS (Rough Indicator for Fallowing)

	Dependent Variable: *Amount of Agricultural Land Used [1-5]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.122^{***}	-0.105^{***}	-0.125^{***}	-0.127^{***}	-0.133^{***}	-0.135^{***}
	(0.029)	(0.034)	(0.040)	(0.038)	(0.032)	(0.039)
	[0.029]	[0.032]	[0.035]	[0.033]	[0.026]	[0.030]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	3.00	3.00	3.00	3.00	3.00	2.98
Adjusted R2	0.179	0.210	0.249	0.238	0.310	0.324
Beta Coef.	-0.438	-0.376	-0.448	-0.454	-0.477	-0.491
Observations	63	63	63	63	63	61

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Amount of Agricultural Land Used* is a 1 to 5 categorical variable, where 1=<10% of agricultural land used per year, 2=10-29% of agricultural land used per year, 3=30-49% of agricultural land used per year, 4=50-99% of agricultural land used per year, and 5=≥100% of agricultural land used per year. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* include the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We focus on the first three categories, which together account for 93% of the farming systems in the sample. We generate a 0 to 2 variable where 0 = "continuous cropping (no fallow period)", 1 = "continuous cropping with multiple rotations (includes short fallow period)", and 2 = "shifting cultivation (with long fallow period)". We estimate a variant of equation (2), where the unit of analysis is a plot. Standard errors are two-way clustered by country and ethnologue group. Table 3 presents the results.[22] The positive coefficient associated with the fallow requirement suggests that longer fallow requirements are presently correlated with forms of cultivation that rely more on fallowing. This suggests that the fallow requirement measure not only predicts historical practices, but is correlated with present-day practices in the context of Africa.

4.3. *Fallow Lengths and Historical Land Rights*

We next test the main hypothesis that longer fallow requirements are associated with a higher prevalence of communal land rights instead of private land rights. We estimate equation (1) for societies where the outcome variable is the "Communality of Land" variable. We present results for the SCCS sample, which was selected to be representative of the EA societies, and for our augmented sample, which includes newly coded societies in addition to the original SCCS sample. Figure 5 presents binscatters examining the relationship between a society's FAO fallow requirement and the extent to which land rights were communal. Consistent with our hypothesis,

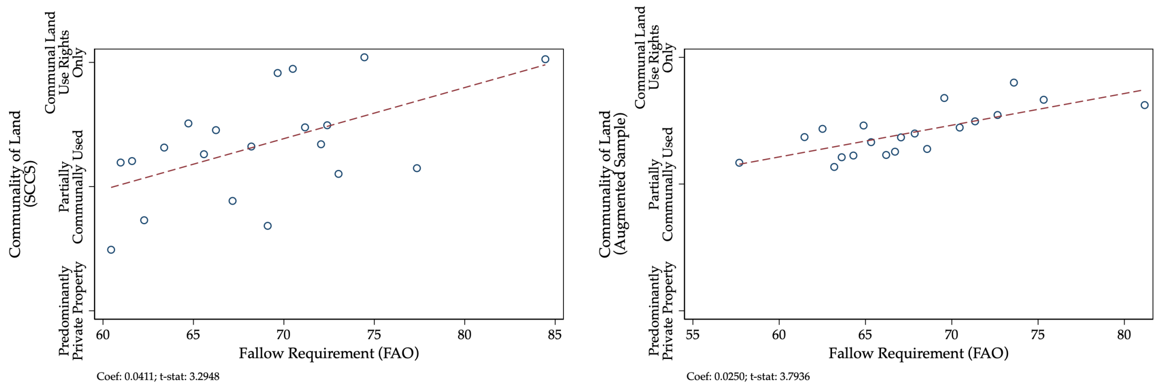
[22] Table C3 presents estimates from an ordered logit specification.

Table 3: Effect of Fallow Requirement on Contemporary Fallowing Practices

	Dependent Variable: *Contemporary Fallowing Practices [0-2]*				
	(1)	(2)	(3)	(4)	(5)
Fallow Requirement	0.013**	0.012*	0.012*	0.015**	0.014**
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]
Country FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	0.72	0.72	0.72	0.72	0.72
Adjusted R2	0.044	0.048	0.052	0.057	0.057
Beta Coef.	0.112	0.104	0.101	0.133	0.125
Observations	10,744	10,744	10,744	10,744	10,744
Clusters	121	121	121	121	121

Notes: The unit of observation is a plot in the *An agricultural survey for more than 9,500 African households* survey (Waha et al. 2016). Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Contemporary Fallowing Practices* is a 0 to 2 categorical variable, increasing in the amount of fallow. All regressions include controls for household head age and gender. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 5: Effect of Fallowing Requirement on Communal Land Rights



a. SCCS Sample

b. Augmented Sample

Notes: The figure present the binscatter between the fallow requirement and the communality of land property rights. The unit of observation is a society in (a) the SCCS and (b) in the augmented sample. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic using robust standard errors.

we find that societies that had longer fallow requirements were more likely to have communal property rights over land.

Table 4 presents the estimates for equation (1) while sequentially including geographic and ethnographic covariates. Columns (2)-(5) include the geographic covariates and crop fixed effects; column (6) adds the ethnographic controls.[23] Across all specifications, we find a positive and statistically significant relationship between fallow requirements and the presence of communal land rights: a 10 percentage point increase in the fallow requirement is associated with a 0.35 increase in the communality of land rights measure (panel A, column 6). The results suggest that fallow requirements were an important factor determining how communities organized land ownership. We find similar effects in our augmented sample; however the point estimates are slightly smaller: a 10 percentage point increase in the fallow requirement is associated with a 0.24 increase in the communality of land rights measure (panel B, column 6). This is likely because the augmented sample includes fewer societies that were identified as having predominantly private property. We present both sets of estimates because the SCCS has the benefit of being chosen to be representative of the broader set of EA groups, but the augmented sample helps address small sample size concerns and external validity.

We provide several robustness tests of the relationship between fallow requirements and communal land rights across both samples in Appendix Section C.1. First, Table C4 presents results with a binary outcome for communal land rights, aggregating partially communal and fully communal land rights. Second, Table C5 presents estimates from an ordered logit specification to account for the ordinal nature of the communality of land measure. Table C6 presents results using a measure of fallow requirements that defines the maximum CSI crop as the pre-Columbian exchange crop. Table C7 presents estimates using an alternative measure for the fallow requirements faced by societies that takes the average fallow requirement for the top-3

[23] Note that many of the ethnographic variables could also be affected by fallow lengths and are potentially "bad controls". For this reason, we show results with and without their inclusion.

Table 4: Effect of Fallow Requirement on Communal Land Rights

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement	0.043***	0.039***	0.035***	0.038***	0.036**	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)	(0.015)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.013]
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.115	0.201	0.267
Beta Coef.	0.329	0.296	0.269	0.286	0.276	0.266
Observations	88	88	88	88	88	86
	Panel B: Augmented Sample					
Fallow Requirement	0.020***	0.021***	0.025***	0.025***	0.026***	0.024***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.41	2.41	2.41	2.41	2.41	2.40
Adjusted R2	0.022	0.209	0.227	0.229	0.224	0.273
Beta Coef.	0.158	0.174	0.204	0.202	0.209	0.193
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

maximum caloric-suitability crops. Finally, in Table C8, we present the coefficient on suitability for agriculture, which is included as a geographic control variable in our specifications. We do this to address the concern that the fallow requirement measure is actually capturing lower agricultural suitability. However, while we find a consistent effect of fallow length on property rights over land, we find no consistent relationship between suitability for agriculture and property rights. Taken together, these results suggest a robust relation between longer fallow requirements and communal land rights.

4.4. Fallow Lengths and Contemporary Land Rights

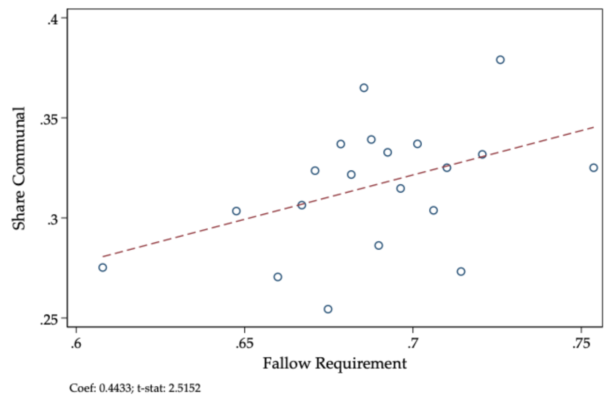
Contemporary Communal Land: We next examine whether these historical patterns are reflected in contemporary communal land tenure using the LandMark data described in Section 3.4. We estimate equation (2) at the ethnolinguistic-group level, where the dependent variable is the share of an Ethnologue territory that overlaps with LandMark communal-land polygons. Figure 6 presents a binscatter examining the relationship between a group's fallow requirement and the share of its territory recorded as collectively held in LandMark. In line with the historical results, we find a clear positive relationship: ethnolinguistic groups that faced longer historical fallow requirements are more likely to have a larger share of their territory under communal tenure today.

Table 5 presents these contemporary estimates from equation (2). Across specifications that sequentially add various geographic covariates, historical controls, and contemporary controls, the coefficient on the fallow requirement remains positive and statistically significant. Throughout, we include country fixed effects, which ensures that we are comparing groups within the same country, absorbing cross-country differences in institutions, land administration, and data quality. The estimates imply that ethnolinguistic groups in the upper part of the fallow distribution have substantially larger shares of their territory under communal tenure in LandMark than groups in the lower part of the distribution.

Evidence from the Afrobarometer: As an additional test of how fallow requirements shape contemporary land rights – and to corroborate the LandMark-based evidence – we use data from Afrobarometer Round 8 (Afrobarometer 2019). This round of the Afrobarometer has questions on the role of traditional leaders for allocating land and for governing the community. We expect that where fallow requirements are longer and thus communal property rights more likely, local leaders should also have a greater role in the allocation and management of land. Consistent with this, in Table C9, we find that traditional leaders across Africa are more likely to have an active role in allocating land and governing the community where there are longer fallow requirements.

Micro-Evidence from Congo: We next turn to micro-level evidence from the Democratic Republic of the Congo (DRC) to complement the cross-country patterns from LandMark and the Afrobarometer. We use original survey data collected from rural villages in the DRC, which allows us to examine the relationship between village-level fallow requirements and land institutions at a micro-level within a single country. We use data from a household and village leader survey conducted in 302 villages across the territories of Gemena, Kungu, and Lisala in former Equateur

Figure 6: Effect of Fallowing Requirement on Contemporary Communal Land



Notes: The figure presents a binscatter of the relationship between the fallow requirement and the share of territory that is communally held, as measured by LandMark (LandMark 2025). The unit of observation is an Ethnologue language group linked to an Ethnographic Atlas society. The underlying regression controls for latitude, longitude, and country fixed effects. The bottom-left of the figure reports the estimated slope coefficient and associated t-statistic using robust standard errors.

Table 5: Effect of Fallow Requirement on Contemporary Communal Land

	Dependent Variable: *Share Communal, [0-1]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.456***	0.429**	0.444**	0.495**	0.461**	0.457**
	(0.172)	(0.204)	(0.204)	(0.205)	(0.213)	(0.213)
	[0.106]	[0.119]	[0.120]	[0.120]	[0.121]	[0.121]
Country FEs	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Population Controls	N	N	N	N	N	Y
Outcome Mean	0.32	0.32	0.32	0.32	0.32	0.32
Adjusted R2	0.694	0.698	0.698	0.701	0.702	0.702
Beta Coef.	0.050	0.047	0.049	0.055	0.050	0.050
Observations	6,713	6,713	6,713	6,713	6,001	6,001
Clusters	990	990	990	990	876	876

Notes: The unit of observation is an ethnologue group linked to an Ethnographic Atlas society. Standard errors clustered by Ethnographic Atlas society in parentheses. The dependent variable *Share Communal* is defined as the percent of area per ethnologue group that is collective land according to LandMark. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, the proportion of the local environment that is tropical or subtropical, an index of settlement density, and an index of political development. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

province (2016–2017) (Lowes et al. 2024). The survey includes randomly sampled villagers (over 3,500) and village leaders (including village chiefs, notables, sages, and secretary to the chief). For each village, we construct the ecologically determined fallow requirement, which we use as our treatment variable. We estimate a variant of equation 1 at the individual level:

$$y_{iv} = \gamma_3 \text{Fallow Requirement}_v + \mathbf{X}'_{iv}\mathit{\Gamma} + \mathbf{Z}'_v\mathit{\Phi} + \varepsilon_{iv} \tag{3}$$

where y_{iv} is the outcome of interest for individual i in village v. $\mathbf{X}'_{iv}$ includes individual-level controls (gender, age, and age squared), $\mathbf{Z}'_v$ includes village-level geographic controls (land suitability, mean precipitation, log village size, elevation, malaria ecology, the tsetse fly suitability index, distance to the nearest river, fixed effects for the village's modal crop) and the share of peasants who are farmers. We report robust standard errors clustered at the village level in parentheses and Conley standard errors using a 50 km cut-off window in brackets.

Table C10 presents our estimates from equation 3. As a validation, column (1) confirms that the ecologically determined fallow requirement predicts actual fallow lengths reported by village leaders: longer fallow requirements are associated with an increase in reported fallow length. This provides reassurance that the ecological measure captures meaningful variation in local agricultural practices, paralleling the validation exercise in Table 2 using the SCCS cropping index and Table 3 examining contemporary fallowing practices. Turning to land titles, column (2) shows that longer fallow requirements are associated with a significantly lower share of villagers holding land titles (note, however, that most individuals do not have titles for their land). This is consistent with the paper's central prediction: where fallow requirements are longer and communal property rights are more prevalent, formal individual land titles are less common.

Columns (3) and (4) examine the role of traditional leaders in land governance. We find that longer fallow requirements are associated with greater chief responsibility for land allocation (column 3) and for resolving land conflicts (column 4). These results are consistent with the Afrobarometer findings and suggest that in environments with longer fallow requirements — where communal tenure is more prevalent — local leaders play a more active role in land governance.[24] These findings from within the DRC corroborate the cross-country patterns documented previously and reinforce the interpretation that ecological determinants of fallowing have lasting consequences for property rights institutions and the way communities manage access to land.

5. Land Policy Implications

Having established that longer fallow requirements are associated with more communal land rights, we now examine the implications for the success of land policies. We use two complementary sources of evidence: World Bank project ratings and the academic evaluation literature on land-tenure interventions.

[24] Additionally, Table C11 examines whether fallow requirements also shape how villagers access and use land. In Column (1) we find that longer fallow requirements are associated with villagers cultivating significantly more plots. Column (2) shows that longer fallow requirements are associated with smaller plot sizes. Finally, column (3) presents results for distance to largest plot; the point estimate is positive but not statistically significant. Taken together, the pattern of more but smaller plots is consistent with communal land management systems in which land is periodically redistributed or reallocated by traditional authorities, rather than consolidated into large private holdings.

5.1. *Evidence from World Bank Projects*

Many scholars and policy makers have posited that private property rights for land are essential for economic development and, therefore, policies should aim to increase their prevalence in developing economies (e.g., de Soto 2000; de Soto and Cheneval 2006). This influential view impacted World Bank policy and led to multiple reforms aimed at titling land, especially in the 1990s and 2000s across Africa and Latin America (Deininger and Binswanger 1999; Deininger and Feder 2009). For instance, in 2005, the World Bank alone was supervising a portfolio of more than U.S. $1 billion worth of land administration projects (Galiani and Schargrodsky 2011). However, many of these reforms have had mixed and often disappointing results (e.g., Platteau 1996; Jacoby and Minten 2007; Vendryes 2014; Lawry et al. 2017; McGuirk and Nunn 2024; Ribar 2025). In recent years, the World Bank has shifted away from principally promoting private land titling and has acknowledged some beneficial aspects of communal land rights (World Bank 2011).

Given these lackluster results despite immense foreign investment in titling policies, Easterly (2007) hypothesized that the lack of success may occur because land titling reforms ignore underlying property rights norms, where land rights are often communal rather than individual and private, and their reasons for existing. Colonial land tenure reforms often faced resistance for precisely this reason. For instance, the British colonial land reforms in Kenya sought to privatize land in settings where customary land rights were strong and well-defined; this led to low levels of take-up and, instead, efforts to recognize communal land rights (Easterly 2007; Home 2013). Similar efforts were undertaken by the Belgians during the colonial era in the DRC, through a land re-organization scheme called the *paysannat*. The goal was to modernize land tenure systems – transitioning from communal to individually managed land. Ultimately, the effort was not as successful as hoped as it faced substantial resistance from clan leaders (Salacuse 1985; Clement 2013).

To explore whether the success of present-day land policies interacts with the underlying land right structures, we use World Bank project data provided by AidData (2017). These data cover World Bank funded projects between 1995 and 2014 and include information on the projects' location, description, and sectors. To examine the success of projects, we explore the outcome rating of projects. A subset of projects are given an outcome rating based on "the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently". The outcome rating is a six point categorical scale ranging from highly unsatisfactory project to highly satisfactory project. We limit the sample to those projects that are given a rating.[25]

We use information on project sectors and project description to classify whether projects involved land administration or not. We define a project as a land administration project if one of its five sector categories or the project title refer to land administration following the keywords used by the World Bank to identify these projects (World Bank Independent Evaluation Group 2016). Specifically, the project is labeled as a land administration project if the description or sector includes one of the following keywords: titling, title, land reform, property right,

[25]We also test whether there is a differential likelihood of receiving a project rating based on the fallow requirement. We find no evidence that this is the case in Appendix Table C12.

land administration, land registration, land development project, cadastre, land records, or land management. We exclude urban projects (i.e. those projects that include the following key words: urban or real estate).

To examine whether project outcomes differ for land administration projects relative to other projects as a function of the fallow requirement, we estimate the following pooled regression:

$$\begin{aligned} y_{pe} = \gamma_1 \left(\text{Fallow Requirement}_e \times \mathbf{1}(\text{Land Admin.}_p)\right) + \gamma_2 \, \text{Fallow Requirement}_e + \gamma_3 \, \mathbf{1}(\text{Land Admin.}_p) \\ + \mathbf{X}_e^{\prime G} \Gamma + \mathbf{X}_e^{\prime E} \Phi + \delta_{r(e)} + \delta_{\tau(p)} + \delta_{\sigma(p)} + \varepsilon_{pe} \end{aligned} \tag{4}$$

where y_{pe} is the World Bank outcome rating for project p matched to ethnologue group e. $\text{Fallow Requirement}_e$ is the standardized ancestral fallow requirement for ethnologue group e. $\mathbf{1}[\text{Land Admin.}_p]$ is an indicator variable equal to one if project p is classified as a land administration project. Our coefficient of interest is γ_1, which captures whether land administration projects are differentially less successful in places with longer fallow requirements. We include $\mathbf{X}_e^{\prime G}$, a vector of geographic covariates, and $\mathbf{X}_e^{\prime E}$, historical pre-colonial ethnographic covariates, both measured at the ethnologue-group level. We also include continent fixed effects $\delta_{r(e)}$, project-year fixed effects $\delta_{\tau(p)}$, and project-sector fixed effects $\delta_{\sigma(p)}$ to absorb differences across regions, time periods, and sectors that could otherwise confound the comparison. In our most demanding specification, we additionally include country fixed effects, which ensures that the differential performance of land administration projects in environments with longer fallow environments is identified from within-country variation across ethnologue groups, netting out any country-level confounders such as differences in institutional quality. Standard errors are clustered at the ethnologue-group level to account for within-group correlation across projects.[26]

We test whether regions that historically had longer fallow requirements – and therefore are suited to communal land rights – have less successful land administration projects. In particular, we compare the success of land projects and non-land projects by ancestral fallow requirements. We present the estimates of equation (4) in Table 6. On average, World Bank projects receive a rating between moderately satisfactory and satisfactory in our sample. For land administration projects, we find a significant negative effect of fallow requirements on the rating received: a one standard deviation increase in the fallow requirement is associated with approximately a 0.5 point decrease in the project rating.[27]

Additionally, in Figure 7, we present binscatters of the relationship between the fallow requirement and World Bank project ratings for land administration and non-land administration projects separately. The figure shows that land administration projects are significantly less successful in places with longer fallow (7a). We do not find a similar effect when examining other types of projects (7b). These results suggest that the success of titling reforms may depend on the underlying property rights regimes. We interpret these results as potential evidence of mismatch between land policy interventions and the institutional and cultural environment.

We can further decompose the project rating into its sub-components, which distinguish between World Bank performance and local and government performance. As shown in Table C13, the negative relationship between fallow requirements and land administration project success is primarily driven by the implementation phase of projects: local implementing agencies and government performance account for the observed negative effects, while Bank-related factors such as preparation and supervision show no significant relationship with fallow requirements.

[26] We also report Conley standard errors in brackets to account for spatial autocorrelation.

[27] We present results using country-level fallow requirements in Table C15 to examine whether the results are sensitive to the exact geo-location of projects; we find that the results are similar using country-level fallow requirement measures.

Table 6: Effect of Fallow Requirement on World Bank Project Success

	Dependent Variable: *World Bank Project Rating [1-6]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement × Land Admin. Project	-0.566^{***}	-0.565^{***}	-0.528^{***}	-0.509^{***}	-0.504^{***}	-0.507^{***}
	(0.129)	(0.126)	(0.127)	(0.126)	(0.126)	(0.128)
	[0.081]	[0.079]	[0.074]	[0.072]	[0.072]	[0.074]
Continent FEs	N	Y	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y	Y	Y
Project Year FEs	N	N	Y	Y	Y	Y
Geography Controls	N	N	N	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Country FEs	N	N	N	N	N	Y
Outcome Mean	4.20	4.20	4.20	4.20	4.20	4.20
Adjusted R2	0.017	0.039	0.130	0.152	0.154	0.273
Beta Coef.	-0.068	-0.068	-0.064	-0.062	-0.061	-0.061
Observations	29,483	29,483	29,427	29,427	29,427	29,426
Clusters	1,652	1,652	1,652	1,652	1,652	1,651

Notes: The unit of observation is a project location-ethnologue pair. Standard errors are clustered at the ethnologue level and presented in parentheses. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Land Administration Project* is an indicator variable equal to 1 if the project title or sector includes keywords related to land administration and 0 otherwise. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

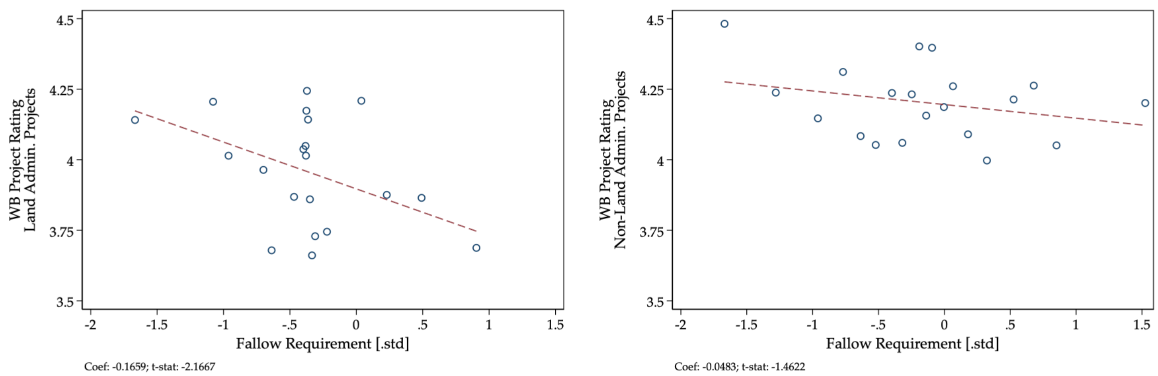
Table C14 explores whether the negative relationship between fallow requirements and the success of land administration projects varies over time. Specifically, we split the sample in half into projects approved before and after 2005. This cutoff reflects a period around when the World Bank began rethinking its approach to land reforms, moving away from an exclusive emphasis on private property rights and increasingly acknowledging the importance of communal land tenure systems (Deininger and Binswanger 1999; World Bank 2011). If this shift in policy reduced the mismatch between project design and local land norms, we would expect the negative effect of fallow requirements to weaken for projects approved after 2005. Consistent with this hypothesis, we find that the negative relationship between fallow requirements and project ratings is driven by earlier projects: for projects approved before 2005, longer fallow requirements significantly reduce the success of land administration projects. In contrast, we find no significant relationship between fallow requirements and project outcomes for projects approved after 2005, and the coefficient is much smaller in magnitude. This pattern suggests that the World Bank's evolving approach to land policy may have mitigated the policy mismatch, reducing the negative impact of fallow requirements on project success over time.

5.2. *Evidence from Academic Impact Evaluations*

To complement the World Bank project-level evidence, we examine whether longer fallowing requirements predicts that land tenure interventions are less effective in the academic evaluation literature. Specifically, we ask whether the direction of estimated impacts reported in published evaluations varies systematically with country-level fallow requirements.

We use the study-level coding assembled by Tseng et al. (2021), which systematically reviews empirical evaluations of land tenure interventions on a wide range of economic and social outcomes. The data compiled by Tseng et al. (2021) are well suited to this exercise because they assemble a systematic review of

Figure 7: Fallow Requirements and World Bank Project Success: Binscatters



a. Land Administration Projects

b. Non-Land Administration Projects

Notes: The figure presents binscatters between the World Bank project success rating for projects related to land administration (a) and projects not related to land administration (b) and fallowing requirements. The unit of observation is a project-ethnologue pair. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue level. The regressions control for latitude and longitude and include continent, project sector, and project year fixed effects.

quantitative evaluations of land-tenure interventions in low- and middle-income countries. Their dataset covers 117 studies in 42 countries and spans a wide range of empirical designs and outcome domains. Importantly for our purposes, much of the underlying literature focuses on titling and formalization interventions, allowing us to examine whether the sign of estimated impacts from these reforms varies systematically with fallow requirements.[28]

For each study, the dataset codes the effects of up to 10 reported outcomes. Each outcome effect is classified as positive, unidentified (no effect or undetermined), or negative based on the underlying estimated coefficient. We reshape the data to the study-outcome level and merge it with our country-level ancestry-adjusted measure of fallow requirements.[29] The resulting matched sample contains 329 study-outcome observations.

This exercise complements the project-level analysis in several respects. First, the unit of observation is now a reported outcome in an academic evaluation rather than a World Bank project rating. Hence, the outcome is closer to a behavioral response to policy change. Second, the outcomes span multiple domains, including investment, agricultural production, land markets, credit, gender, perceptions, and conflict. The mismatch framework delivers a common prediction: if standardized titling or individualization reforms are less well aligned with prevailing land-use institutions in high-fallow settings, then clearly positive estimated effects should be less common in those settings.

Let $Y_{isc} \in \{\text{Positive}, \text{Unidentified}, \text{Negative}\}$ denote the sign of outcome i reported in study s conducted in country c. We estimate a multinomial logit model where unidentified is the omitted base outcome. We examine the effects of Fallow Requirement$_c$, our country-level fallow requirement measure. We include X_{isc}, which are outcome-domain fixed effects and, depending on the specification, controls for intervention type, baseline tenure category, whether a counterfactual is used in the study, publication year, and our set of standard controls: geography, disease environment, crop fixed effects, and ethnographic characteristics. We also include continent fixed effects. For ease of interpretation, we report average marginal effects of fallow requirements on the probability that an outcome is coded positive, unidentified, or negative.

[28]We note that one limitation of these data is selection into publication; we may be less likely to observe studies that get unexpected or null results.

[29]We exclude four multi-country studies for which no unique country-level fallow requirement can be assigned.

We weight observations by the inverse number of outcomes reported in each study so that every study contributes equal total weight. We cluster standard errors at the country level.

Table 7 reports the main estimates. Across specifications, longer fallow requirements are associated with a lower probability that an estimated effect is coded as positive and a higher probability that it is coded as unidentified or negative. In the baseline specifications, a one-unit increase in the Fallow Requirement lowers the probability of a positive finding by about 3 percentage points, raises the probability of an unidentified finding by about 2 percentage points, and raises the probability of a negative finding by about 1 percentage point. In our most demanding specification (column 5), which adds geographic, ethnographic, disease, and crop controls, the shift is concentrated primarily from positive to unidentified outcomes: the probability of a positive finding falls by 4.7 percentage points, the probability of an unidentified (no or undetermined) finding rises by 6.5 percentage points, and the estimated change in the probability of a negative finding is small and statistically indistinguishable from zero. Notably, this pattern suggests that clearly positive impacts become less common in higher-fallow settings, and the distribution of estimated effects shifts toward unidentified or mixed findings rather than toward systematically negative ones — consistent with the interpretation that land reforms under-perform relative to expectations in high-fallow environments.

This pattern is consistent with the central prediction of the mismatch framework. Our main analysis uses World Bank administrative ratings to show that land interventions perform worse in higher-fallow environments; the results here show that the sign distribution of estimated impacts in the academic evaluation literature shifts in the same direction. Taken together, these findings strengthen the external validity of the mismatch hypothesis.

6. Further Implications: Social Insurance and Conflict

Given the evidence that land titling reforms are less successful in places with longer fallow – and hence a greater likelihood of having communal property rights, we ask what benefits there may be to communal property rights. Put differently, why might communities prefer communal land rights in places with longer fallow? Guided by our conceptual framework, we examine the implications of fallow length for wealth inequality, wealth, and the incidence of conflict. We also examine heterogeneity by quality of institutions because our conceptual framework applies in a setting with low state capacity. Finally, we also explore whether places with longer fallow requirements exhibit greater resilience to adverse climate shocks, a pattern our framework predicts if the communal institutions that emerge in these ecologies facilitate flexible resource reallocation when shocks hit.

Note that, throughout our analysis, we focus on the reduced form effects of fallow requirements. Our interpretation for this analysis is that the fallow requirement affects our outcomes of interest through its effect on the suitability for and presence of communal land rights – as highlighted in our conceptual framework in Section 2.5. However, we do not formally estimate instrumental variables estimates of the effect of communal land rights on outcomes. This is because changes in land institutions inevitably co-evolve with changes in social norms regarding land (Platteau 2006; Di Tella et al. 2007; Henrich 2020), making it challenging to satisfy a strict interpretation of the exclusion restriction assumption in this case. Thus, we focus on the reduced form effects of fallow requirements on our outcomes of interest guided by our conceptual framework, with the caveat that we cannot rule out that fallow requirements affect outcomes outside of property rights structures.

Table 7: Fallow Requirements and the Sign of Estimated Impacts in the Evaluation Literature

	Dependent Variable: *Average marginal effect on probability outcome is coded: Positive / Unidentified / Negative*				
	(1)	(2)	(3)	(4)	(5)
Δ Pr(*Positive*)					
Fallow Requirement	-0.027^{***}	-0.028^{***}	-0.027^{***}	-0.027^{***}	-0.047^{**}
	(0.009)	(0.009)	(0.009)	(0.009)	(0.020)
Δ Pr(*Unidentified*)					
Fallow Requirement	0.016^{**}	0.017^{**}	0.016^{**}	0.016^{**}	0.065^{***}
	(0.008)	(0.008)	(0.008)	(0.008)	(0.018)
Δ Pr(*Negative*)					
Fallow Requirement	0.011^{***}	0.011^{***}	0.011^{***}	0.011^{***}	-0.018
	(0.004)	(0.004)	(0.004)	(0.004)	(0.014)
Continent FEs	Y	Y	Y	Y	Y
Outcome-domain FEs	Y	Y	Y	Y	Y
Intervention-type Controls	N	Y	Y	Y	Y
Baseline tenure Controls	N	N	Y	Y	Y
Counterfactual Controls	N	N	N	Y	Y
Publication year Controls	N	N	N	Y	Y
Geography Controls	N	N	N	N	Y
Disease Controls	N	N	N	N	Y
Crop FEs	N	N	N	N	Y
Ethnographic Controls	N	N	N	N	Y
Pseudo R2	0.16	0.16	0.16	0.16	0.16
Observations	329	329	329	329	329
Clusters	35	35	35	35	35
Mean Fallowing Requirement	65.12	65.12	65.12	65.12	65.12
Pr(Positive)	0.64	0.64	0.64	0.64	0.64
Pr(Unidentified)	0.29	0.29	0.29	0.29	0.29
Pr(Negative)	0.07	0.07	0.07	0.07	0.07

Notes: This table uses coded results from Tseng et al. (2021). The unit of observation is a study-outcome pair. Each outcome is coded as Positive, Unidentified, or Negative. Unidentified outcomes correspond to estimates that are statistically indistinguishable from zero or for which no clear direction of effect is identified. We estimate multinomial logit models (base outcome: Unidentified) and report average marginal effects of *Fallow Requirement* on the probability that an outcome is coded as Positive, Unidentified, or Negative. Observations are weighted so that each study contributes equally (inverse of the number of outcomes reported in each study). Standard errors (in parentheses) are clustered at the country level. *Outcome-domain FEs* classify outcomes into categories such as investment, production and welfare, conflict, perceptions, credit, land markets, gender, and others. *Intervention-type controls* include indicators for titling and formalization, land-use planning, policy reforms, capacity building, and awareness-raising interventions. *Baseline tenure controls* capture pre-intervention tenure arrangements. *Counterfactual controls* indicate whether the study includes a comparison or counterfactual group. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop. *Ethnographic Controls* include settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.1. *Inequality and Wealth*

As highlighted in Section 2.5, our conceptual framework predicts that long fallow requirements, by favoring communal institutions, should be associated with lower income inequality. In the model, the mechanism for reduced inequality is that those who have high costs of monitoring benefit from the communal provision of protection, an implicit form of redistribution. Anecdotal evidence suggests that communal land rights may also allow for greater flexibility in redistributing land across households (Goldstein and Udry 2008).[30]

To examine modern-day inequality and wealth, we use data from the Demographic and Health Surveys (DHS). We assembled all DHS samples that included geographic coordinates for enumeration clusters. In total, the sample includes 123 surveys spanning 47 countries; Figure A9 presents a map of the location for the DHS clusters in our sample and a list of survey-waves included in the analysis. The DHS data include

[30] In fact, Goldstein and Udry (2008) note the following in their paper:

> "We interpret the resilience of this system of [communal] land tenure to its crucial and flexible role in redistributing resources in the face of unobserved variations in need...This system may provide important insurance in times of need and a remarkable degree of social stability due to the redistribution of land within rural communities."

wealth score measures for each surveyed household. The wealth score is constructed using principal component analysis of household asset ownership within each country-year survey. We use the wealth score measures to examine cluster-level income levels and inequality levels. We link DHS clusters to ethnologue groups based on their location to determine the fallow requirement for each DHS cluster.

Table 8 presents the regression estimates for the relationship between wealth scores in the DHS data and the fallow requirements of ethnologue groups. We first examine whether longer fallow requirements are associated with less income inequality, as proxied by either the standard deviation (columns (1) and (2)) or the inter-quartile range (columns (3) and (4)) of the wealth score. We find that across both of these measures longer fallow requirements are associated with a reduction in inequality. A one standard deviation increase in the fallow requirement is associated with a .021 standard deviation reduction in the inter-quartile range of the wealth score. These results are robust to a number of geographic and ecological covariates and country-survey-year fixed-effects.[31]

Interestingly, we find little evidence that fallow requirements significantly affect average wealth scores (columns (5) and (6)): the point estimates are statistically insignificant. However, the beta coefficient is of a similar magnitude to the inequality estimates. Therefore, as an alternative proxy for average wealth levels, we also examine the impacts of fallow requirements on contemporary night light density (Elvidge et al. 2017). The results, presented in Table C16, do not provide strong evidence that there is a significant relationship between fallow requirements and night light density. The results suggest that societies that have longer fallow requirements – and are therefore more suitable for communal land rights – experience less income inequality.

6.2. Conflict

Fallow requirements, by increasing the likelihood of communal property rights, may also reduce the incidence of conflict. In our model, the reduction in conflict is generated by both the higher level of monitoring provided in the communal regime and the increase in redistribution across members in the communal regime. In practice, it may be that communal land rights are more secure – particularly in a low state capacity setting.

To explore this mechanism, we use two complementary sources of data. First, we use geo-referenced conflict data from ACLED (Raleigh et al. 2010). These data have broad coverage, capturing conflict events from 1997-2021 for Africa, 2016-2021 for Latin America, and 2018-2021 for all other countries. We construct annualized conflict rates by dividing total events by the number of years of ACLED coverage for each region to account for differences in years of coverage. However, the ACLED data do not consistently disentangle whether conflict events are land-related or not. To capture whether a conflict event was due to land conflicts, we follow the methodology in Eberle et al. (2020) to construct measures of "land-related" violence using the "notes" recorded for each event. We identify instances that mention land issues in the description.

Second, to complement the ACLED data, we also use data from the Institutional Profiles Database (IPD) (French Ministry for the Economy and Finance 2016). The IPD records the severity of land-related conflict at the country level. The IPD data was constructed using surveys completed by country or regional Economic Services agents of the French Ministry for the Economy and Finance. The benefit of these data is that they provide high-quality measures from experts. However, the data covers only 95 countries and relies on perceptions rather than on specific reports or instances of conflict.

Table 9 presents the regression estimates for the relationship between the annual number of conflict events in the ACLED data and the fallow requirement of the ethnologue group. We find that longer

[31]See Table C17 for results on each outcome when controls are included sequentially.

Table 8: Effect of Fallow Requirement on Income and Inequality:
Demographic and Health Surveys (DHS)

	Dependent Variable: *... of DHS Wealth Score*					
	Inter-Quartile Range		*Standard Deviation*		*Average*	
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.545^{***}	-0.509^{***}	-0.401^{***}	-0.398^{***}	-1.018	-0.641
	(0.190)	(0.189)	(0.114)	(0.122)	(0.645)	(0.719)
	[0.323]	[0.320]	[0.242]	[0.240]	[0.760]	[0.749]
Country-Year FEs	Y	Y	Y	Y	Y	Y
Geography Controls	Y	Y	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y	N	Y
Outcome Mean	78.23	78.93	62.87	63.46	-2.80	-0.86
Outcome SD	101.61	104.63	77.04	79.43	165.79	170.17
Adjusted R2	0.539	0.541	0.625	0.627	0.222	0.218
Beta Coef.	-0.024	-0.021	-0.023	-0.022	-0.027	-0.016
Observations	66,167	61,773	66,169	61,775	66,169	61,775
Clusters	114	114	114	114	114	114

Notes: The unit of observation is a DHS cluster. Standard errors are two-way clustered by country-survey wave and ethnologue group and are presented in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. *Inter-Quartile Range* is the inter-quartile range of the DHS wealth score. *Standard Deviation* is the standard deviation of the DHS wealth score. *Average* is the average DHS wealth score. All regressions control for the number of observations per DHS cluster and rural-urban status. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each DHS cluster. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

fallow requirements are associated with less conflict. These results are robust to a number of geographic and ecological covariates and country fixed-effects. Furthermore, we also include controls for population density in columns 5 and 6 to address concerns that fallow requirements directly impact population density and that lower population density drives the relationship with conflict. We find that our results are unaffected by the inclusion of population density controls. The results are consistent with the model predictions and suggest that societies with longer fallow requirements – and thus more communal land rights – experience less conflict.

Finally, we examine the relationship between fallow requirements and land-specific conflict events across ACLED and the IPD. Figure C2 presents the binscatter for the number of land-related conflicts in the ACLED data. It shows that areas with longer fallow requirements have fewer land-related conflicts. Figure C3 provides the binscatter for the severity of land-related conflict across countries from the IPD data; it also shows that countries with longer fallow requirements tend to have less land-related conflict. The IPD also reports expert-coded measures of land tenure security in rural areas. Thus, we can test whether the fallow requirement undermines land tenure security. Figure C4 presents a binscatter for extent of land tenure security in rural areas using the IPD data. We find that countries with longer fallowing requirements do not have less land security. Overall, the results suggest that longer fallow requirements may lead to a reduction in land-related conflict.

Table 9: Effect of Fallow Requirement on Conflict

	Dependent Variable: *Annual Number of Conflict Events*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-2.245^{**}	-2.826^{***}	-2.922^{***}	-2.081^{**}	-1.997^{**}	-2.359^{**}
	(1.117)	(1.012)	(1.012)	(0.950)	(1.000)	(1.009)
	[1.121]	[1.051]	[1.048]	[0.983]	[1.029]	[1.027]
Country FEs	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Population	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	35.59	35.59	35.59	35.59	37.79	37.79
Outcome SD	435.95	435.95	435.95	435.95	457.92	457.92
Adjusted R2	0.185	0.189	0.189	0.194	0.198	0.215
Beta Coef.	-0.024	-0.030	-0.031	-0.022	-0.020	-0.023
Observations	6,718	6,718	6,718	6,718	6,006	6,006

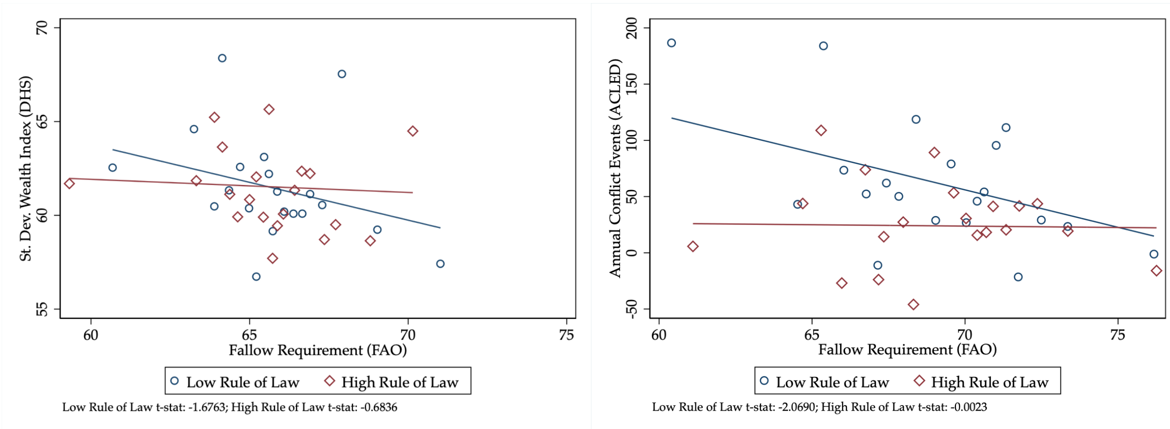
Notes: The unit of observation is an ethnologue group. Standard errors clustered at the ethnologue level are presented in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Annual Number of Conflict Events* is defined as the average annual number of conflict events per ethnologue group in the ACLED data (1997–2021 for Africa, 2016–2021 for Latin America, and 2018–2021 for all other countries). *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Population* includes log population for each group. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.3. *Heterogeneity by State Capacity*

We next examine heterogeneity in our results guided by the conceptual framework. One key implication of this framework is that fallow requirements are likely to matter most in settings without a strong state to enforce property rights. Therefore, we also examine whether the effects of fallow requirements for income inequality and conflict vary by state capacity. Specifically, we examine this relationship by separately estimating effects for countries with high (above median) and low (below median) "Rule of Law" as measured by the World Bank Governance Indicators data (Kaufmann and Kraay 2023). This is motivated by the observation that we expect the effects of fallow requirements on our outcomes of interest to be particularly pronounced in settings with low state capacity, where the state is unlikely to be able to enforce property rights.

Figure 8a presents the binscatter for the standard deviation of the wealth score by high and low rule of law countries. We find that the negative relationship between inequality and fallowing requirements is concentrated in low rule of law countries. This provides suggestive evidence that communal land rights might be particularly effective at reducing inequality in settings with weak states. Figure 8b presents the binscatter for the annual number of conflict events in the ACLED data by high and low rule of law countries. Again, we find that the negative relationship between conflict and historical fallowing requirements is concentrated in low rule of law countries. This suggests that communal land rights (relative to private land rights) might be particularly effective at reducing conflict in settings with weak states.

Figure 8: Fallowing Requirements, Inequality & Conflict: Heterogeneity by Rule of Law



a. Inequality

b. Conflict

Notes: The figure presents binscatters between the fallow requirements and (a) the standard deviation of the DHS wealth score measure and (b) the number of conflict events in the ACLED data. The unit of observation is (a) a DHS cluster and (b) an ethnologue group. The figure presents results separately for groups in countries with low (below median) and high (above median) Rule of Law measures from the World Bank Governance Indicators dataset. Regressions control for country-survey-year fixed effects, geography controls, and disease controls. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic for each subset of countries. Standard errors are clustered at the ethnologue group level.

6.4. *Resilience to Climate Shocks*

Our results suggest that there are fewer conflicts in places where the fallow requirement is higher and thus communal land rights are likely more prevalent. As discussed in Section 2, communal land rights may be more flexible, allowing communities to redistribute resources to those in need. This increased flexibility may mean that in the face of negative income shocks, communities are more resilient, and conflict is less likely to emerge. We test this hypothesis using data on negative rainfall shocks. We leverage the time variation in rainfall shocks and conflict events.

The estimating equation is:

$$\begin{aligned} y_{ict} =& \beta_1 \text{Negative Rainfall Growth}_{it} + \beta_2 \text{Negative Rainfall Growth}_{it} \times \text{Fallow Requirement}_i \\ &+ \alpha_i + \alpha_{c(i)} \times t + \epsilon_{ict} \end{aligned} \tag{5}$$

where, y_{ict} is the outcome of interest (e.g., number of conflict events) in cell i in country c at time t. Our unit of observation is a .5 × .5 degree grid cell. As before, the Fallow Requirement$_i$ is the percentage of time during the fallow-cropping cycle that land should be fallowed for a cell i. α_i are grid cell fixed effects that control for time-invariant differences across grid cells and $\alpha_{c(i)t} \times t$ are country-specific time trends. We two-way cluster standard errors at the .5 × .5 degree grid cell and climate-zone by year levels.

Following Miguel et al. (2004), our measure of rainfall shocks is Negative Rainfall Growth$_{it}$ which captures the deviation of observed rainfall at time t from the historical average rainfall recorded between $t-6$ and $t-1$ in grid cell i. This deviation is normalized by the average rainfall within the same historical period. Our rainfall data are from the Global Precipitation Climatology Centre (Schneider et al. 2023). The data include monthly estimates of rainfall measured in centimeters at a .5 × .5 degree grid cell level. The data cover a period from 1970 to 2022, and we aggregate these data to the annual level for our study. We expect a positive coefficient for β_1, which would indicate that negative rainfall growth is associated with more conflict. Furthermore, if longer fallow requirements attenuate the impacts of negative rainfall shocks on conflict, we hypothesize that β_2 would be negative.

Table 10: Negative Rainfall Growth and Conflict

	Dependent Variable: Number of Conflict Events						
	ACLED				UCDP		
	Land	Non-State	State	Any	Non-State	State	Any
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Negative Rainfall Growth (t)	0.051*	1.065**	0.246	1.364	0.093**	0.315	0.408
	(0.026)	(0.458)	(0.737)	(1.017)	(0.037)	(0.244)	(0.256)
Negative Rainfall Growth (t) × *Fallow Requirement*	−0.001*	−0.014**	−0.002	−0.017	−0.001**	−0.004	−0.005*
	(0.000)	(0.006)	(0.010)	(0.013)	(0.001)	(0.003)	(0.003)
Cell FEs	Y	Y	Y	Y	Y	Y	Y
Country Trend	Y	Y	Y	Y	Y	Y	Y
Outcome Mean	0.022	0.534	0.655	1.188	0.018	0.165	0.184
Observations	243,668	243,668	243,668	243,668	1,294,272	1,294,272	1,294,272
Climate-Zone-Year Clusters	417	417	417	417	864	864	864
Cell Clusters	29,397	29,397	29,397	29,397	40,446	40,446	40,446

Notes: The unit of observation is a .5 × .5 degree grid-cell and year. Standard errors are clustered by climate zone year and .5 × .5 degree grid-cell. Across columns the outcome variables are continuous variables measuring the number of violent conflicts at time t in grid cell i. The data are from the Armed Conflict Location & Event Data Project (ACLED) in columns (1) to (4) and from the Uppsala Conflict Data Program (UCDP) in columns (5) to (7). *Land* is the number of land-related conflicts in cell i at time t. *Non-State* is the number of violent conflicts not involving the state in cell i at time t. *State* is the number of violent conflicts involving the state in cell i at time t. *Any* is the number of violent conflicts in cell i at time t. Every specification includes .5 × .5 degree grid-cell fixed effects and a country trend. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We use geo-referenced conflict data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010) to explore this hypothesis. We present results for four types of conflict: land conflict, non-state conflict, state conflict and any conflict. For an event to be recorded in the UCDP database, it must satisfy two main criteria. First, it must involve at least one fatality. Second, the conflicting parties, either together or individually, must have been responsible for a minimum of 25 deaths within a single calendar year. Moreover, at least one of the parties in the conflict must be an organized entity, such as a government or a politically structured rebel group or militia. In contrast, the ACLED database has less stringent inclusion criteria, with no specific requirement for a certain number of fatalities either annually or per event. Therefore, ACLED may be more effective at documenting smaller, local conflicts, including those related to land disputes.

We present the estimates of equation (5) in Table 10. We find that negative rainfall shocks are associated with increases in land-related conflict and non-state conflict. Furthermore, we find that the relationship between negative rainfall shocks and conflict is attenuated in places with a longer fallow requirement. The relationship is only statistically significant for land-related and non-state conflicts, the types of conflicts we would expect to be most affected by communal property rights. These results provide suggestive evidence that communal land rights may help prevent small-scale local conflict and land-related conflict. The magnitude of the effect is also meaningful. For example, when rain is 50% lower in a year relative to the 5-year average, the number of land conflicts in a place where the fallow requirement is 50% increases by about 2.3% of the mean. In contrast, in settings where the fallow requirement is 70%, the combined effect is negative, suggesting that higher fallow requirements fully attenuate the impact of negative rainfall shocks on land conflict.

7. Conclusion

Historically, communal land rights have been more common than private land rights in much of the world. However, there has been a strong focus on private and individual land rights in development policies, specifically with the implementation of various titling reforms in developing countries. This paper addresses two important questions. First, we examine one potential ecological determinant of the prevalence of communal land rights – the ecologically determined fallow requirement. We then explore how fallow requirements, by making areas potentially more suitable for communal land rights in settings with low state capacity, interact with development policy.

We find that communal land rights evolve endogenously in response to ecological forces. In particular, we systematically test the hypothesis that communal land rights were more common in areas with longer fallow requirements. This is because land with longer fallow requirements faces higher protection costs, which favors the adoption of communal land rights over private land rights in settings with low state capacity. Combining various ecological and ethnographic data sets, we provide empirical evidence that longer fallowing requirements are strongly associated with communal land rights relative to private land rights. This is the case in the original SCCS sample and in our augmented sample that codes land rights for an additional 228 societies. Furthermore, our fallow requirements measure predicts present day land arrangements across multiple data sets, including LandMark, Afrobarometer, and original survey data from the DRC.

We then examine how this ecological variation in fallow requirements shapes the performance of land policy, especially in low-state-capacity settings where communal tenure may be better adapted to local conditions. We ask whether titling reforms are less successful in places where where the underlying ecology makes communal land rights more adaptive. Consistent with this interpretation, we find that World Bank land administration projects receive lower outcome ratings in environments with longer fallow, and that positive estimated impacts of land tenure reforms are systematically less common in impact evaluations conducted in these settings. Together, these results suggest a mismatch between interventions that seek to privatize and individualize land rights and the underlying communal property rights regime in places with longer fallow requirements.

Guided by our model, we then examine whether places with long fallow periods exhibit patterns consistent with benefits from communal land tenure. We find that in places with longer fallow requirements, there is a reduction in inequality and in land conflicts, particularly when there is low state capacity. Additionally, longer fallow requirements are associated with greater resilience from conflict in the face of negative rainfall shocks. This has important implications for land policy in the context of developing countries. The results suggest important benefits of communal land tenure regimes when states are weak and speak to their persistence.

Broadly, our results provide insight into the economics of property rights over land. Property rights are a bundle of various rights (e.g., use rights, inheritance rights, transfer rights), and these bundles display considerable variation worldwide. These bundles emerge, at least in part, in response to the ecological environment. Understanding the drivers of variation in the structure of property rights over land, as well as the benefits and costs of varied land tenure regimes, is potentially a valuable path forward for designing more effective land policies.

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Online Appendix for:

Fallow Lengths and the Structure of Property Rights

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13 April 2026

Appendix A. Data Sources, Variable Definitions, and Samples

A.1. Data Sources and Variable Definitions

Geographic Data:

- Elevation: NOAA National Geophysical Data Center (2009)
- Fallow requirement: Fischer et al. (2012)
- Land suitability: Ramankutty et al. (2002)
- Longitude: Murdock and White (1969)
- Malaria ecology index: Kiszewski et al. (2004)
- Maximum caloric suitable crop: Galor and Ozak (2016)
- Precipitation: Fick and Hijmans (2017)
- Suitability for the plough: Galor and Ozak (2016)
- Temperature: Fick and Hijmans (2017)
- Tsetse fly suitability: Alsan (2015)

Ethnographic Data:

- Ethnologue: Giuliano and Nunn (2018)
- Standard Cross Cultural Sample: Murdock and White (1969)
- Ethnographic Atlas: Murdock (1967)

Additional Data Sources:

- ACLED: Raleigh et al. (2010)
- Afrobarometer: Afrobarometer (2019)
- Agricultural survey for more than 9,500 African households: Waha et al. (2016)
- Demographic and Health Surveys: Boyle et al. (2022)
- Institutional Profiles Database: French Ministry for the Economy and Finance (2016)
- Landmark: LandMark (2025)
- Rainfall: Schneider et al. (2023)
- World Bank Project Data: AidData (2017)
- Land tenure evaluations data: Tseng et al. (2021)
- UCDP Uppsala Conflict Data Program (2021)
- Legal Origins: La Porta et al. (2008)

- Rule of Law: Kaufmann and Kraay (2023)
- Nightlights: Elvidge et al. (2021)
- Population density: Center for International Earth Science Information Network - CIESIN - Columbia University (2018)

Variable Definitions:

- **Fallow Requirement**: We use FAO models to construct the fallow requirement for the maximum caloric-suitability crop as defined by data from Galor and Ozak (2016) for 5′ × 5′ cells across the world. The FAO estimates fallow requirements for various crops as a non-linear function of local soil types, temperature, crop growth cycles, and moisture. The fallowing requirement is measured as the percentage of time during the fallow-cropping cycle the land must be under fallow.
- **Communality of Land**: We measure the communality of land using data from the Standard Cross-Cultural Sample (Murdock and White 1969) (variable v1726 in the SCCS). The variable takes three values: where 1 is "land is predominantly private property", 2 is "land is partially communally used", and 3 is "communal land use rights only".
- **Cropping Index**: We use the Cropping Index measure for each society in Standard Cross-Cultural Sample (Murdock and White 1969) (variable v1128 in the SCCS). This variable is defined as the "Amount of Agricultural Land Used (Rough Indicator for Fallowing)". The measure is a 1 to 5 categorical variable, where a value of 1 corresponds to "<10% of agricultural land used per year", 2 to "10-29% of agricultural land used per year", 3 to "30-49% of agricultural land used per year", 4 to "50-99% of agricultural land used per year", and 5 to "≥100% of agricultural land used per year".
- **Contemporary Communal Land**: We use the LandMark platform (LandMark 2025) to construct a measure of contemporary communal land holdings at the ethnolinguistic-group level. LandMark maps lands held or claimed collectively by Indigenous peoples and local communities (whether or not these rights are formally recognized by the state), but does not map open-access areas, state lands, or individually titled private parcels. For each Ethnologue language group linked to an Ethnographic Atlas society, we overlay its contemporary location with LandMark polygons and compute the percentage of the group's territory that is classified as collectively held or claimed.
- **Contemporary Fallowing Practices**: We use data from Waha et al. (2016) to measure contemporary fallowing practices. The dataset provides information on the farming system for all plots held by farm households. The exact survey question is "Please answer the following land use questions with respect to total amount and type of land operated by members of the household: System of Farming". For each plot, respondents can select one of the six following farming systems: (i) shifting cultivation (with long fallow period), (ii) continuous cropping (no fallow period), (iii) continuous cropping with multiple rotations (includes short fallow period), (iv) livestock grazing land, (v) other, and (vi) combination of the above. We generate a 0 to 2 variable where 0 is "continuous cropping (no fallow period)", 1 is "continuous cropping with multiple rotations (includes short fallow period)", and 2 is "shifting cultivation (with long fallow period)".
- **Influence of Traditional Leaders in Governing Community**: We use data from Afrobarometer (2019) to measure the role of traditional leaders in governing the community. The exact survey question is "Now let's talk about traditional leaders and their role in politics and

government in this country. How much influence do traditional leaders currently have in each of the following areas: Governing your local community". Respondents could select one of the following four responses: (i) "A lot", (ii) "Some", (iii) "A small amount", (iv) "None", or "Don't know". We construct a 0 to 3 variable where 0 is "None", 1 is "A small amount", 2 is "Some", and 3 is "A lot".

- **Influence of Traditional Leaders in Allocating Land**: We use data from Afrobarometer (2019) to measure the role of traditional leaders in allocating land. The exact survey question is "Now let's talk about traditional leaders and their role in politics and government in this country. How much influence do traditional leaders currently have in each of the following areas: Allocating land". Respondents could select one of the following four responses: (i) "A lot", (ii) "Some", (iii) "A small amount", (iv) "None", or "Don't know". We construct a 0 to 3 variable where 0 is "None", 1 is "A small amount", 2 is "Some", and 3 is "A lot".

- **World Bank Project Rating**: We measure a World Bank project's rating using data from AidData (2017). Specifically, we use the "IEG Outcome Rating", which is defined as "the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently". The World Bank Project Rating variable ranges from 1 to 6, where 1 is "highly unsatisfactory", 2 is "unsatisfactory", 3 is "moderately unsatisfactory", 4 is "moderately satisfactory", 5 is "satisfactory", and 6 is "highly satisfactory".

- **World Bank Project Rating, Land Titling Projects**: We catalog whether a World Bank project is a land project using data from AidData (2017). We define an indicator variable equal to 1 if the project title ("project title" variable), project name ("project name"), main theme ("theme 1"), or main goal ("goal 1") includes one of the following key words: titling, title, land reform, property right, land administration, land registration, land development project, cadastre, land records, land management; otherwise, the variable takes a value equal to 0. Furthermore, to exclude urban land projects, we set the variable equal to 0 is by excluding projects where the project title, project name, main theme, or main goal includes any of the following key words: urban or real estate.

- **Land tenure evaluation outcomes**: Tseng et al. (2021) denote outcomes as having positive, unidentified, or negative effects. Positive means that the effects for that outcome are positive and significant; unidentified effects are null results or inconclusive; negative means that the effects are negative and significant.

- **Inter-Quartile Range of DHS Wealth Score**: We construct the inter-quartile range of the DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). The wealth score is "a composite measure of a household's cumulative living standard". It is constructed using Principal Component Analysis (PCA) and measures of a household's ownership of selected assets (e.g., televisions), household quality (e.g., roof materials), and access to water and sanitation.[1] For each DHS cluster, we calculate the inter-quartile range of the wealth score for survey respondents in the DHS cluster. We exclude DHS clusters that have fewer than twenty survey respondents. We multiply the measure by 100 to ease the interpretation of coefficients.

- **Standard Deviation of DHS Wealth Score**: We construct the standard deviation of the DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). For each DHS cluster with over twenty survey respondents, we calculate the standard deviation of the wealth score for survey respondents in the DHS cluster. We multiply the measure by 100 to ease the interpretation of coefficients.

[1]For more information, see https://dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm.

- **Average of DHS Wealth Score**: We construct the average DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). For each DHS cluster with over twenty survey respondents, we calculate the average of the wealth score for survey respondents in that DHS cluster. We multiply the measure by 100 to ease the interpretation of coefficients.

- **Any-Conflict**: We compute any-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). In UCDP's dataset, the primary unit of analysis is defined as 'a distinct incident of lethal organized violence where an organized actor engages another organized actor or civilians, resulting in at least one direct death'. For a conflict to be recorded, it must involve a cumulative fatality count exceeding 25 deaths between the involved actor pairs. UCDP's dataset offers a global perspective, encompassing the years 1989 to 2020. ACLED's data focuses on 'an event characterized by a violent confrontation between two organized armed groups at a specific time and location'. This dataset does not require a minimum death toll for an event's inclusion. ACLED's coverage includes African regions from 1997 to 2020, Latin America from 2016 to 2020, and the remainder of the world from 2018 to 2020.

- **State-Conflict**: We compute state-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). We classify conflict as state-based if one of the two parties involved is the state, such as the military, government militia or the police.

- **Non-State Conflict**: We compute Non-state-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). We classify conflict as non-state-based if the two parties involved are non-state actors such as rebel groups or militias.

- **Land Conflict**: We compute land-conflict counts at the .5-degree by .5-degree grid cell level, using ACLED data (Raleigh et al. 2010). We follow the methodology in Eberle et al. (2020) to construct measures of "land-related" violence using the "notes" recorded for each event to find instances that mention land issues in the description. Specifically, we search for the following keywords: dispute over land, control of land, over land, clash over land, land grab, farm land, land invaders, land invasion, land redistribution, land battle, over cattle and land, invade land, over disputed land, over a piece of land, farm, crop, and harvest.

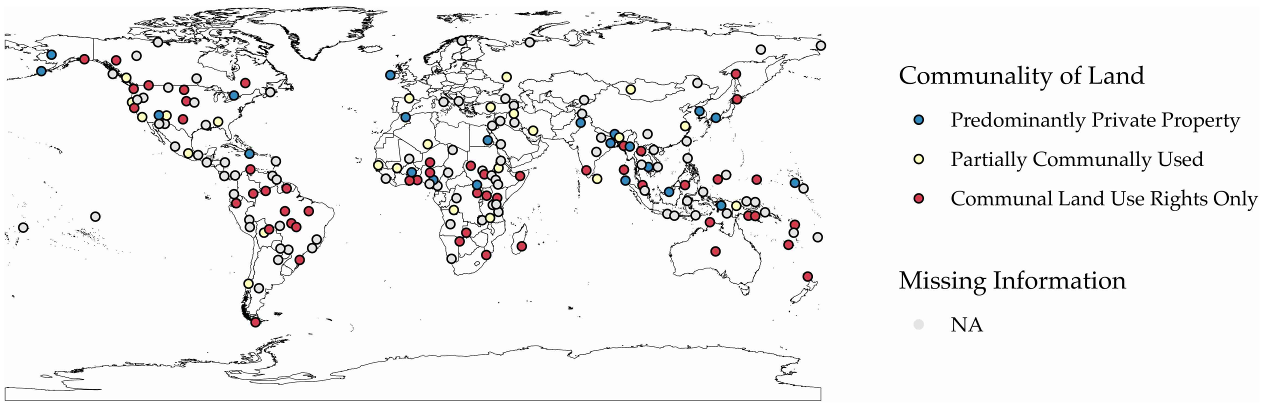
- **Negative Rainfall Growth**: We compute negative rainfall growth as the deviation of observed rainfall at time t from the historical average rainfall recorded between $t-6$ and $t-1$. This deviation is normalized by the average rainfall within the same historical period. The measure is calculated at a spatial resolution of .5-degree by .5-degree grid cells. A higher negative rainfall growth value indicates a more severe negative deviation from the average, signifying a stronger negative rainfall shock. The rainfall data employed for this computation is from Schneider et al. (2023).

- **Nightlight Intensity**: We measure the intensity of nightlights using data from Elvidge et al. (2021). We define our measure as the log of the mean night light intensity plus one in the VIIRS data for 2019.

- **Intensity of Agriculture**: We measure the intensity of agricultural production using variable v232 from the Standard Cross-Cultural Sample (Murdock and White 1969). The measure is a 1 to 6 categorical variable, where 1 is no agricultural production, 2 is casual agriculture ("incidental to other subsistence modes"), 3 is extensive or shifting agriculture, 4 is horticulture ("vegetal gardens or groves of fruit trees"), 5 is intensive agriculture, and 6 is intensive irrigated agriculture.

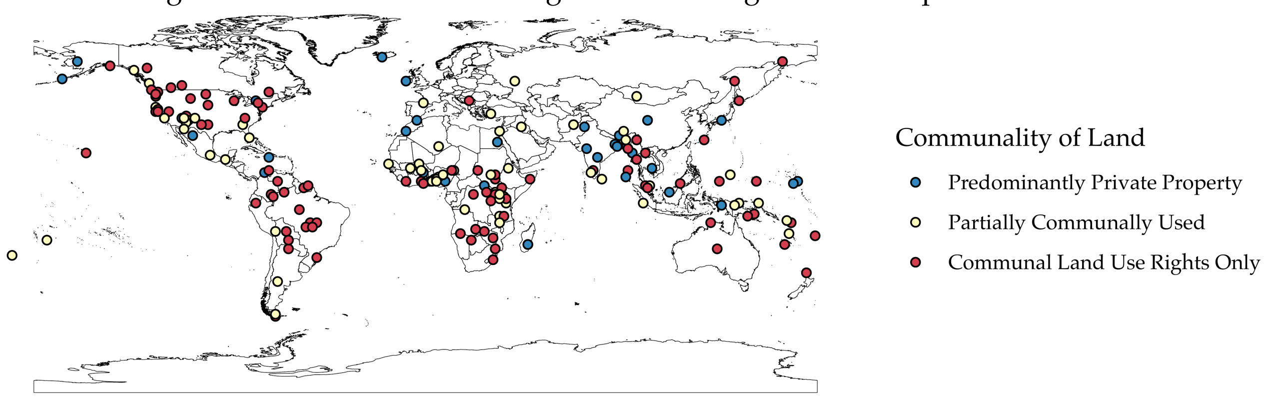
- **Extent of Jurisdictional Hierarchy**: We use the measure of jurisdictional hierarchy beyond the local community from variable v237 in the Standard Cross-Cultural Sample data (Murdock and White 1969). This measure is a 1 to 5 categorical variable, where 1 is no levels ("no political authority beyond the community"), 2 is one level ("e.g. petty chiefdom"), 3 is two levels ("e.g. larger chiefdom"), 4 is three levels ("e.g. states"), and 5 is four levels ("e.g. larger states").

Figure A1: Communal Land Rights Across SCCS Societies



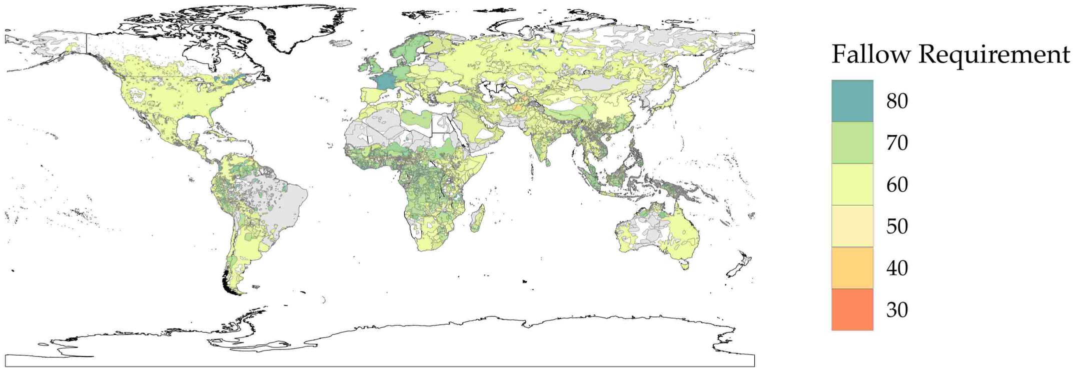
Notes: The map presents the extent to which land rights are organized communally in the SCCS.

Figure A2: Communal Land Rights Across Augmented Sample



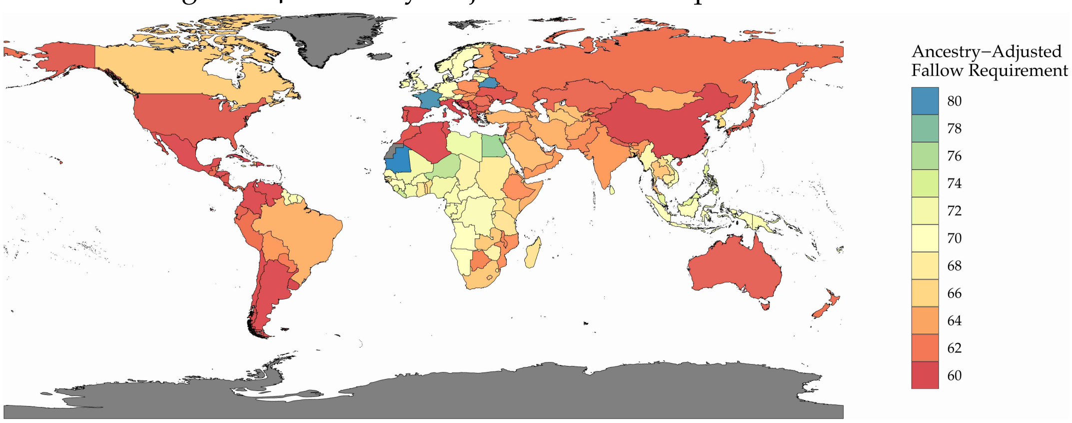
Notes: The map presents the extent to which land rights are organized communally in our augmented SCCS sample.

Figure A3: Fallow Requirements Across Language Groups



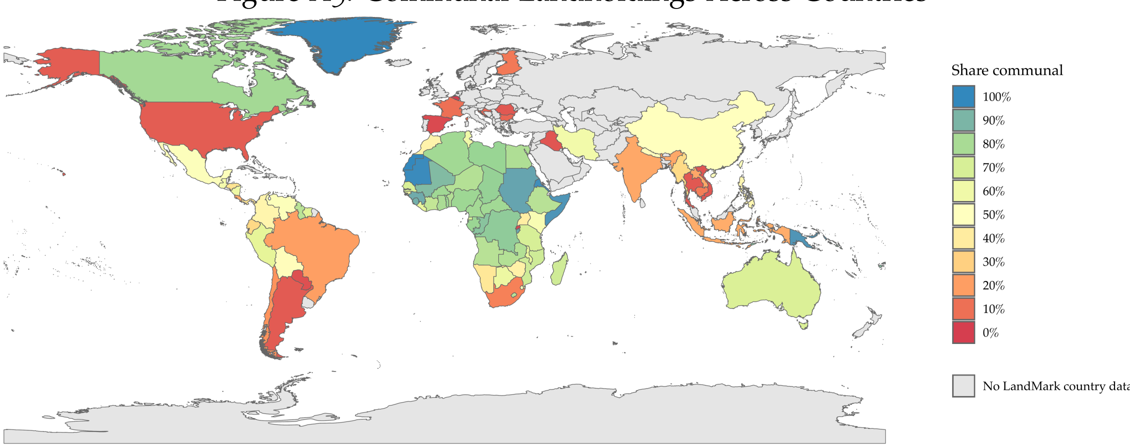
Notes: The map presents the fallow requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric-suitability crop for each language group in the Ethnologue linked to the EA (Giuliano and Nunn 2018). Grey areas represent groups where the land is not suitable for agriculture.

Figure A4: Ancestry-Adjusted Fallow Requirements



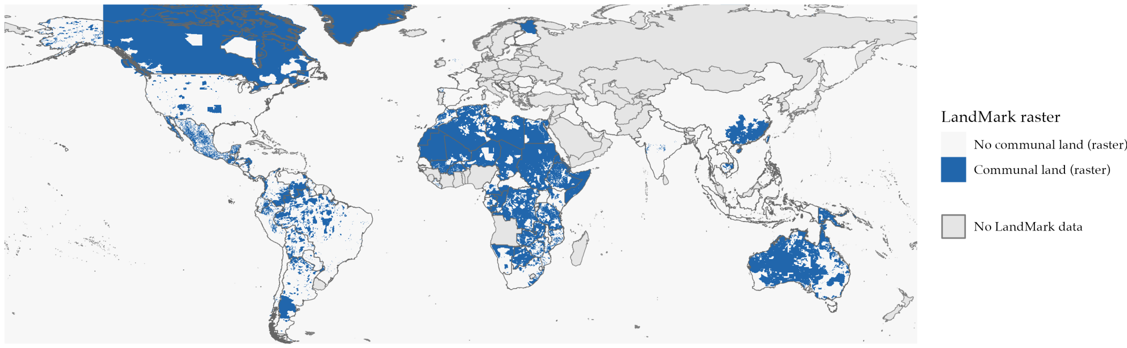
Notes: The map presents the ancestry-adjusted fallowing requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric-suitability crop for each country using the methodology from Giuliano and Nunn (2018). Grey areas represent groups where the land is not suitable for agriculture.

Figure A5: Communal Landholdings Across Countries



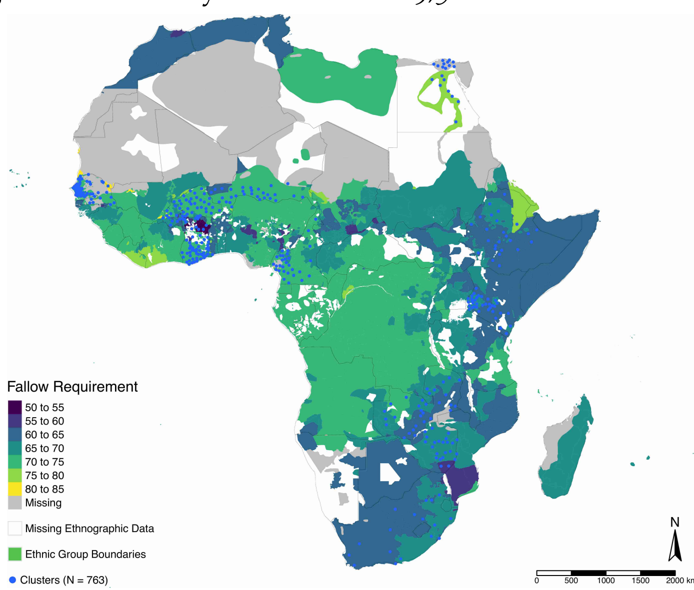
Notes: The map presents the share of a country's land that is communal land according to LandMark (2025).

Figure A6: Communal Landholdings in Landmark



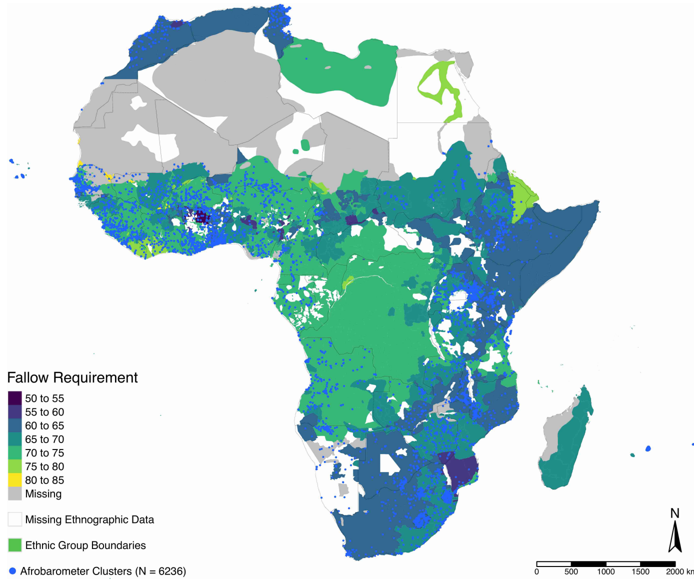
Notes: The map presents locations where land that is communal according to LandMark (2025) from LandMark's Local Communities & Indigenous Peoples (LC/IP) polygons. We include areas that are formally recognized and those claimed/documented but not yet recognized.

Figure A7: "An agricultural survey for more than 9,500 African households" Sample



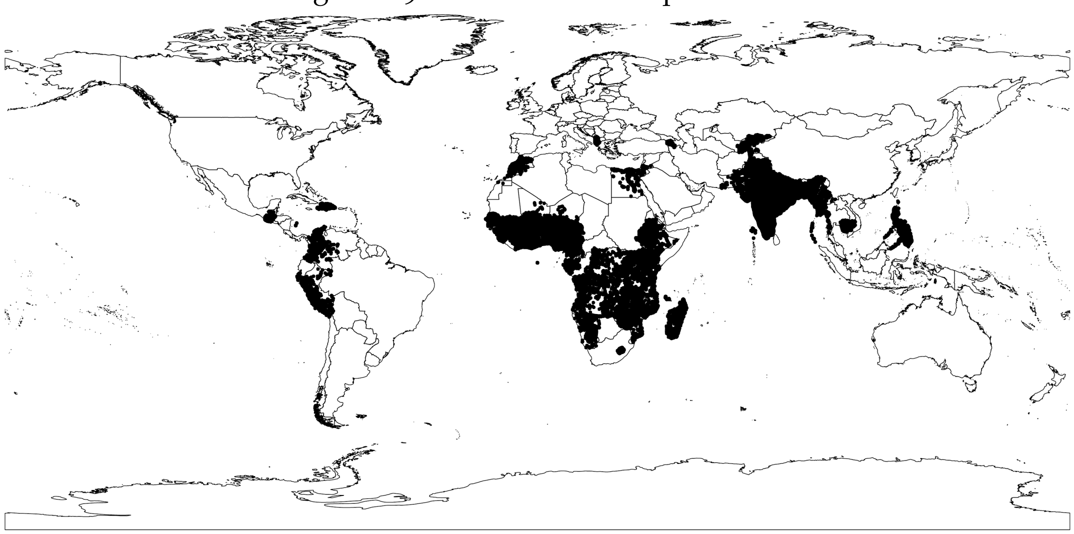
Notes: The map presents the cluster location for the "An agricultural survey for more than 9,500 African households" sample from Waha et al. (2016). In addition, the map also presents the fallow requirement each ethnologue group (Fischer et al. 2012; Giuliano and Nunn 2018). The sample includes the following countries: Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Niger, Senegal, South Africa, Zambia, and Zimbabwe.

Figure A8: Afrobarometer Round 8 Sample



Notes: The map presents the Afrobaromter Round 8 clusters (Afrobarometer 2019). In addition, the map also presents the fallow requirement each ethnologue group (Fischer et al. 2012; Giuliano and Nunn 2018). The Afrobarometer sample includes the following countries: Angola, Benin, Botswana, Burkina Faso, Cameroon, Ivory Coast, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

Figure A9: IPUMS DHS Sample



Notes: The map presents the cluster locations for the Demographic and Health Surveys (DHS) sample. The DHS sample includes the following country-waves: Albania (2008, 2017); Angola (2015); Armenia (2010); Bangladesh (2000, 2004, 2011, 2014); Burkina Faso (1993, 1999, 2003, 2010); Benin (1996, 2001, 2012); Burundi (2010, 2016); Cambodia (2005); Cameroon (1991, 2004, 2011); Colombia (2010); Comoros (2012); Cote d'Ivoire (1994, 1998, 2012); Democratic Republic of the Congo (2007, 2013); Dominican Republic (2007, 2013); Egypt (1995, 2000, 2003, 2005, 2008, 2014); Ethiopia (2000, 2005, 2010, 2016); Gabon (2012); Ghana (1993, 1998, 2003, 2008, 2014); Guatemala (2015); Guinea (1999, 2005, 2012); Haiti (2000, 2006, 2012, 2016); India (2014); Jordan (2002, 2007, 2012); Kenya (2003, 2008, 2014); Kyrgyzstan (2012); Lesotho (2004, 2009, 2014); Madagascar (1997, 2008); Malawi (2000, 2004, 2010, 2015); Mali (1996, 2001, 2006, 2012); Morocco (2003); Mozambique (2011); Myanmar (2015); Namibia (2000, 2006, 2013); Nepal (2001, 2006, 2011, 2016); Nigeria (1990, 2003, 2008, 2013); Niger (1998, 2012); Pakistan (2006); Peru (2009); Philippines (2008, 2017); Rwanda (2005, 2008, 2010, 2014); Senegal (1997, 2005, 2010, 2012, 2015, 2016, 2017); Sierra Leone (2013, 2019); Tajikistan (2012); Tanzania (1999, 2010, 2015); Uganda (2000, 2006, 2011, 2016); Zambia (2007, 2013); Zimbabwe (1999, 2005, 2010, 2015).

A.2. Codifying Ethnographic Data on Property Rights

Our baseline data comes from the SCCS variable 1726, which measures the"Communality of Land" (Murdock and White 1969). This is a 1 to 3 categorical variable, where 1 = land is predominantly private property, 2 = land is partially communally used, and 3 = communal land use rights only. Given that the SCCS only defines the land rights variable for 98 societies, we extend the sample of societies by leveraging additional ethnographic data sources. To extend the number of societies for whom we have data on the structure of property rights, we took the following steps.

1. **Create definition of communality of land rights**: We constructed a working definition of the characteristics of predominantly private property (v1726=1), partially communal property (v1726=2), and fully communal property (v1726=3). To construct the characterizations of each type of property rights, we reviewed the ethnographic sources from societies that were coded in the SCCS for each value of v1726. Based on the description in the ethnographic records for these societies, we constructed a list of the characteristics that reflect how property rights over land often work for each value of v1726. The definitions are reproduced below and were used as a guideline for how to codify additional societies.

    - Predominantly Private Property: Land rights are fully held by individuals or nuclear families. Ownership includes rights to buy, sell, transfer, or inherit land without community or kin-group approval. Land is an alienable commodity and holds value.
    - Partially Communal Property: Personal or family rights exist but are nested within lineage ownership. Land is owned by extended kinship groups or lineages, but families or individuals can have long term use or cultivation rights. Cultivated or actively used land is treated as personal or family property. It can be inherited. Fallow or unused land reverts to communal ownership and can be reallocated. Chiefs or leadership may oversee allocation of communal plots and hold authority over transfers, sales. Sales or alienation outside of the tribe/clan is usually prohibited, but inner kinship exchange is acceptable(lending, shared-use of a specific site).
    - Fully Communal: Land is owned by lineages, clans, or ancestors (or other broader groups) rather than individuals. Chiefs or leaders have strict management and ownership on behalf of the group. Individuals may have usufruct rights (use rights) but may not sell or alienate land. Usufruct rights passed down (e.g., matrilineally or patrilineally) but ownership of land itself is not passed down. Land has strong ritual, spiritual, or ancestral connections or significance.

2. **Coding using the electronic Human Area Relations Files (Ember 2012):** Two research assistants used the electronic Human Area Relations Files (eHRAF) database to independently code how property rights over land are organized for each society present in the Ethnographic Atlas. eHRAF is an online repository of subject-indexed ethnographic records covering groups that are present in the SCCS and the EA (Ember 2012).

- As part of the codification process the RA would login to eHRAF. They would enter the society's name and search terms related to land and property rights.
- They would review the associated ethnographic excerpts that eHRAF would present for that society given the search terms.
- Based on their reading of the evidence, they would choose a value to enter for the property rights over land in that society. They would include the related evidence that they used to make that assessment and the corresponding citation for that evidence.
- If the evidence was unclear or the RA felt that additional explanation was required, they would add additional information to a "Notes" column with any comments.
- In cases where the RA decided there was not sufficient evidence or that the evidence was unclear, they would leave the values as missing.

3. **Rectification of eHRAF independent codings:** An RA then rectified the 2 independent codings. There were several potential cases that the RA faced.

   - Coding from RA1 and RA2 were the same: In this case, the RA reviews the evidence provided by RA1 and RA2 and provides a consolidation of the evidence.
   - One RA had a value; another RA coded as missing: The RA then reviewed the evidence provided by the RA who had a value, and also returned to the eHRAF database. Based on revisiting the evidence provided by the RA that had coded the society, as well as what is in eHRAF, the RA provided a final determination.
   - Coding from RA1 and RA2 differ: In this case, the RA reviewed the evidence provided by both RAs and returned to the eHRAF database. The RA reviewed the entirety of the evidence, and made a final determination to the best of their judgment. The final set of evidence that the RA used to make this assessment and the related citation was then included in the database. These difference arose most often when evidence presented in eHRAF related to sub-groups or related groups to the group of interest, and one RA used this evidence and the other did not.
   - The final output from this process was: an RA1 coding; RA1 evidence, RA2 coding; RA2 evidence; final rectified coding; final rectified supporting evidence.

A.3. Correlates of the Fallow Requirement

In this section, we explore the correlates of the fallow requirement. Our unit of analysis is a group in the Ethnographic Atlas. We estimate the following specification:

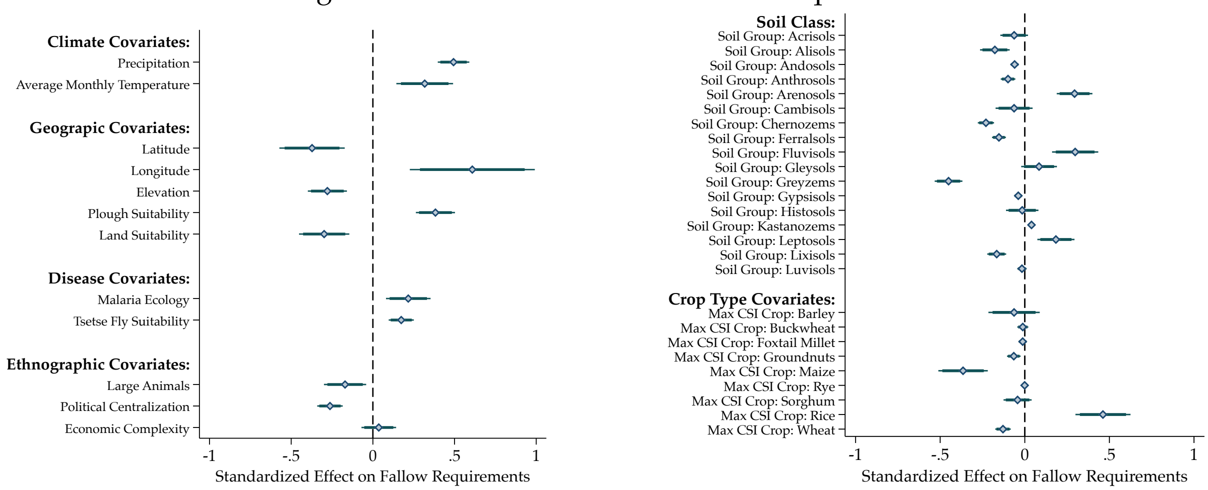
$$y_{scr} = \beta_1 x_{scr} + \delta_{r(c)} + \varepsilon_{scr} \tag{A1}$$

where y_{sc} is the standardized fallowing requirement for group s in country c, measured within 100 kilometers from a group's centroid, and x_{scr} represents the covariates of interest. The specification includes region fixed effects ($\delta_{r(c)}$) for Africa, Americas, Asia, Europe, and Pacific. Standard errors are clustered at the country level c to allow for some degree of spatial autocorrelation.

We examine all climate, geographic, disease, ethnographic, soil class, and crop type covariates, which are included in our baseline specification. The results are presented in Figure A10, where we report the standardized coefficients and standard errors from OLS regressions. The standardized coefficients facilitate direct comparison of the relative importance of each variable.

We find that the fallow requirement is positively correlated with precipitation, average monthly temperature, plough suitability, malaria suitability, and tsetse fly suitability, while negatively correlated with elevation, land suitability for agriculture, historical domestication of large animals, and political centralization. Regarding crops, the fallow requirement is negatively correlated with the probability of growing maize, groundnut, and wheat as the maximum caloric suitable crop and positively correlated with rice.

Figure A10: Correlates of the Fallow Requirement



Notes: This figure presents the standardized coefficients and standard errors from OLS regressions examining the climatic, geographic, disease, ethnographic, soil class and crop type correlates of the fallow requirement. Standard errors are clustered at the country level. All models include continent fixed effects.

Appendix B. Theoretical Framework

In this section, we outline the economic model for how fallow lengths impact property right choices. This model is used to guide the empirical analysis. In the model, longer fallow requirements lead to higher protection costs. These costs could be paid individually (in private land rights) or jointly (in communal land rights). Communal protection has returns to scale but also involves the potential to free ride. We discuss the model setup, payoffs, and predictions below.

B.1. Model Structure

1. The fallow requirement, $f \in [0,1]$, is given by nature. It is exogenous and perfectly observable to all citizens. The fallow requirement f represents the fraction of land that

must be kept fallow each period. The rest of the land $1 - f$ can be cultivated and provides the same cultivation payoff c irrespective of f.[2]

2. Citizens are part of a property rights regime – either private or communal. If communal property rights are the regime, an organizing cost k is paid by every citizen. Private and communal property rights are referred to as individual (I) and group monitoring (G) respectively.

3. Nature assigns a type (monitoring cost) $e_i \in [0,1]$ to every citizen $i \in [0,1]$ (a continuum of citizens). Monitoring ability e is a joint-uniform distribution in [0, 1]. Individuals know only their own type and the joint distribution from which types are realized.[3]

4. In either property rights regime, every citizen plays simultaneously and has two options – to monitor $(a_i = 1)$ or not $(a_i = 0)$. If citizens choose to monitor, they pay a monitoring cost dependent on their type e_i. The higher the type e_i, the higher the monitoring cost. The monitoring cost scales with f – the fallow requirement: higher fallow requirements imply a higher total monitoring cost $(e_i f)$.

5. After citizens choose a_i, they cultivate their land and get a cultivation payoff c. However, with probability p, any individual's land is attacked.[4]

   - In the private regime, whether or not they can protect their land depends on their individual choice a_i. If $a_i = 1$, since the citizen already paid a monitoring cost fe_i, they successfully protect their land. If $a_i = 0$, the citizen did not pay a monitoring cost and they lose the cultivation payoff c. The payoff from $a_i = 1$ is $c - fe_i$, and from $a_i = 0$ is $c - pc$.
   - In the communal regime, whether or not they can protect their land depends on their individual choice a_i and others' choices $(\int_{i=0}^{1} a_i di)$. The communal regime has a returns-to-scale component to group-monitoring. If the fraction of people monitoring is greater than or equal to β, group-monitoring is successful and everybody's land is protected. Also, if group-monitoring is successful, the cost of monitoring gets halved to $\frac{fe_i}{2}$ for all the people that chose to group-monitor. There is an incentive to free-ride

[2]We make this assumption for two reasons. First, it helps us abstract from modeling how previous fallow choices affect cultivation payoffs. Second, FAO models do not indicate that land with higher (lower) fallow requirements are less (more) productive on average if the land is being cultivated.

[3]The mapping $e()$ of individual $i \in [0,1]$ to monitoring type $t \in [0,1]$ is one-to-one, and onto. Let $p_i(t)$ be the probability of individual i being assigned type t. Formally,

$$\forall i, j \in [0,1], p_i(t) = p_j(t)$$
$$\forall i, j \in [0,1], e(i) = e(j) \implies i = j$$
$$\forall t \in [0,1], \exists i \in [0,1] \text{ s.t. } e(i) = t$$

There will always be a distribution of monitoring abilities in the society. It is only unclear what an individual's ability is relative to others. For simplicity, we refer to $e(i)$ as e_i.

[4]For simplicity we treat the probability that an outsider attacks a plot, p, as exogenous. Endogenising p—for example, letting it rise with the share of land left idle when fallow is long—would only strengthen our main comparative statics. Additionally, since p is not independently observable in the ethnographic data, modelling it as an exogenous constant simplifies our empirical mapping between fallow length and property-rights outcomes.

in the communal regime because if group-monitoring is a success, everybody's land is protected even if only some pay the individual monitoring cost in group-monitoring, $\frac{fe_i}{2}$. The payoff from $a_i = 1$ is $c - \frac{fe_i}{2} - k$ if group-monitoring is a success, and $c - fe_i - k$ if group-monitoring is a failure. The payoff from $a_i = 0$ is $c - k$ if group-monitoring is a success, and $c - pc - k$ if group-monitoring is a failure.

B.2. Payoffs

- Private regime payoffs

$$\begin{cases} \underbrace{c}_{1} - \underbrace{fe_i}_{2} & a_i = 1 \\ \underbrace{c}_{1} - \underbrace{pc}_{3} & a_i = 0 \end{cases}$$

- Communal regime payoffs

$$\begin{cases} \underbrace{c}_{1} - \underbrace{fe_i}_{2} + \underbrace{\mathbb{1}\left(\int_0^1 a_i di \geq \underbrace{\beta}_{7}\right) \times \frac{fe_i}{2}}_{4} - \underbrace{k}_{6} & a_i = 1 \\ \underbrace{c}_{1} - \underbrace{pc}_{3} + \underbrace{\mathbb{1}\left(\int_0^1 a_i di \geq \underbrace{\beta}_{7}\right) \times pc}_{5} - \underbrace{k}_{6} & a_i = 0 \end{cases}$$

$$f, \beta \in [0,1];\ c, k \geq 0; e \sim U[0,1]$$

Explanation for terms in payoffs:

1. Cultivation payoff
2. Monitoring cost
3. Probability of attack
4. Returns-to-scale halving monitoring cost
5. Returns-to-scale allowing free-riding
6. Organizing cost
7. Fraction of people required for success of group-monitoring

B.3. Analysis

We compare choices and ultimate payoffs across the two types of property regimes, private (I) or communal (G). In both regimes, citizens (with types) choose to monitor or not based on their type-dependent payoff. To compare payoffs across regimes, given that types are realized after regime choice, we compare the ex-ante expected payoffs in equilibrium – the same for every citizen – for both regimes for a given f.[5]

B.3.1. Private Regime: Expected Payoffs

Given the payoffs above, individuals in the private regime will choose to monitor ($a_i = 1$) only if $e_i \leq \frac{pc}{f}$. Thus:

- The expected payoff in the private regime if $\frac{pc}{f} < 1$ is

$$\begin{aligned}
&= \int_0^{\frac{pc}{f}} (c - fe_i)de_i + \int_{\frac{pc}{f}}^1 (c - pc)de_i \\
&= c\left(\frac{pc}{f}\right) - \frac{f}{2}\left(\frac{pc}{f}\right)^2 + c\left(1 - \frac{pc}{f}\right) - pc\left(1 - \frac{pc}{f}\right) \\
&= c - pc + \frac{(pc)^2}{2f}
\end{aligned}$$

- The expected payoff in the private regime if $\frac{pc}{f} \geq 1$ is

$$\begin{aligned}
&= \int_0^1 (c - fe_i)de_i \\
&= c - \frac{f}{2}
\end{aligned}$$

The expected payoff in the private regime is decreasing in f in both cases:

$$\begin{aligned}
&= c - \frac{f}{2} && f \leq pc \\
&= c - pc + \frac{(pc)^2}{2f} && f > pc
\end{aligned}$$

B.3.2. Communal Regime: Expected Payoffs

To simplify the analysis, we group people in three.

- Group I is the set of people such that $c - fe_i \geq c - pc \implies e_i \in [0, \frac{pc}{f}]$. These people are willing to do individual monitoring regardless of whether group-monitoring is a success or failure.

- Group II is the set of people such that $c - fe_i < c - pc \wedge c - fe_i/2 \geq c - pc \implies e_i \in (\frac{pc}{f}, \frac{2pc}{f}]$. These people can help in group-monitoring (if they expect enough people to monitor, i.e. the share of people monitoring is $> \beta$) but would choose to not do individual monitoring (if they expect too few people to monitor).

[5] Alternatively, one can have individuals choose regimes prior to types being assigned. In other words, they solve the game backwards and choose the regime with the higher expected payoff (which will be the same for all individuals prior to types being assigned). To simplify, we directly compare ex-ante expected payoffs instead of specifying this additional step.

- Group III is the set of people that cannot do group-monitoring or group-monitoring because it is too costly for them. $c - \frac{fe_i}{2} < c - pc \implies e_i \in (\frac{2pc}{f}, 1]$.[6]

With the notation for different groups above, we solve the model:

- Suppose $\beta \leq \frac{2pc}{f}$. In this case, there exist multiple Nash equilibria of the one-shot game where group-monitoring is a "success" (i.e., $> \beta$ share of individuals choose $a_i = 1$). In any equilibrium, Group III always chooses $a_i = 0$. In equilibria where group-monitoring is a success, any set of 'size'/measure β consisting of members from Group I or II chooses group-monitoring. The rest of the people from Group I and II choose to free-ride.

  Why is it a Nash equilibrium? In this equilibrium those who choose group-monitoring know the actions of everybody and do not wish to deviate because group-monitoring fails without them. There is no incentive to deviate because $c - \frac{fe_i}{2} - k \geq c - pc - k$. Also, the people who are free-riding cannot do better than a payoff of $c - k$. In the most efficient Nash equilibrium, β share of individuals choose group-monitoring and everybody else (1-β) free-rides.[7] We assume that the most efficient equilibrium is chosen, because it is the risk-dominant equilibrium. (We discuss this in more detail in section B.4.) The expected payoff in equilibrium is

$$= \int_0^\beta \left(c - \frac{fe_i}{2} - k\right) de_i + \int_\beta^1 (c-k) de_i = c - k - \frac{\beta^2 f}{4}$$

- Suppose $\beta > \frac{2pc}{f}$. In this case, there exists no Nash equilibrium of the one-shot game where group-monitoring is a success. Group I chooses monitoring and Groups II and III choose free-riding/$a_i = 0$. The expected payoff in equilibrium is

$$\begin{aligned} &= \int_0^{\frac{pc}{f}} (c - fe_i) de_i + \int_{\frac{pc}{f}}^1 (c - pc) de_i - k \\ &= c - pc + \frac{(pc)^2}{2f} - k \end{aligned}$$

Thus, the expected payoffs in the communal regime are also decreasing in f

$$\begin{aligned} &= c - k - \frac{\beta^2 f}{4} && f \leq \frac{2pc}{\beta} \\ &= c - pc + \frac{(pc)^2}{2f} - k && f > \frac{2pc}{\beta} \end{aligned}$$

In what follows, we focus on equilibria where free riding is possible. That is, we assume that $f \leq \frac{2pc}{\beta}$.

[6] Of course, it need not be the case that all the groups are present for every possible set of parameter values. For example, $\frac{2pc}{f} > 1 \implies$ Group III does not exist.

[7] Efficiency is defined using the sum of all individuals' payoffs, or equivalently, the ex-ante expected payoff for any individual for a regime.

B.3.3. Model Predictions

Prediction 1: There is an increasing preference for communal land rights as f increases

Figure B1 presents the expected payoffs as a function of f for individuals in the private regime and the communal regime, and Figure B2 presents the difference in expected payoffs between communal and private regimes under specific parameter values for (p, β, c, k).[8] We find that, for high enough fallow requirements f, individuals' expected payoffs are higher in the communal regime than in the private regime.

Figure B1: Payoffs as a Function of Fallow Requirement f
by Land Rights Regime

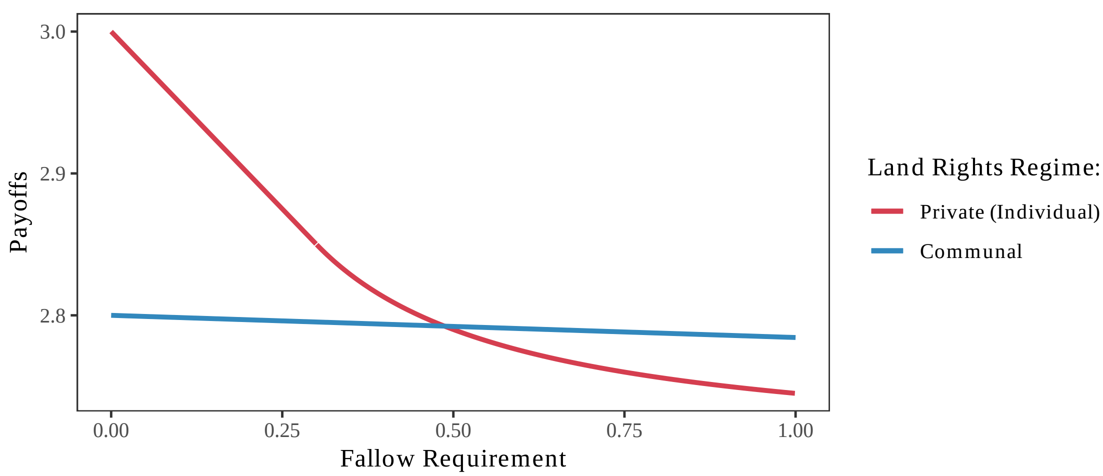
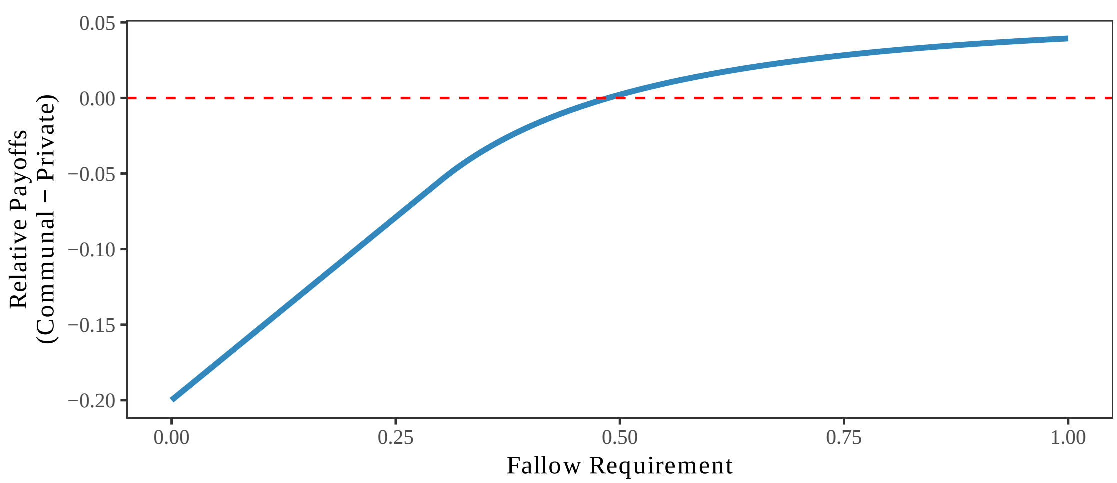


Figure B2: Payoff of Communal Relative to Private Land Rights
as a Function of Fallow Requirement f



Prediction 2: There is an increasing preference for communal land rights as p increases

[8] The plots assume $p = 0.10$, $\beta = 0.25$, $c = 3$, and $k = 0.2$.

- If $pc > 1 \implies p > \frac{1}{c}$,

  Relative payoff (communal - private) as a function of f is

  $$= -k + \left(\frac{2-\beta^2}{4}\right)f \qquad \forall f \in [0,1]$$

  and $\forall p > \frac{1}{c}$ relative payoff is independent of p

- If $pc \leq 1 \implies p \leq \frac{1}{c}$,

  Relative payoff as a function of f is

  $$\begin{aligned} &= -k + \left(\frac{2-\beta^2}{4}\right)f && f \leq pc \\ &= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4}f && 1 \geq f \geq pc \end{aligned}$$

  Relative payoff as a function of p is

  $$\begin{aligned} &= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4}f && p \leq \frac{f}{c} \\ &= -k + \left(\frac{2-\beta^2}{4}\right)f && \frac{1}{c} \geq p \geq \frac{f}{c} \end{aligned}$$

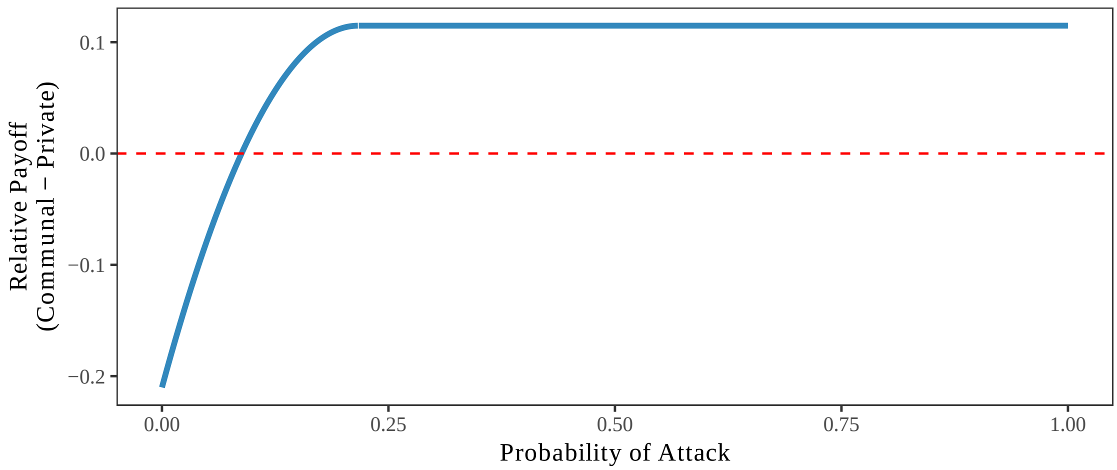
Thus, relative payoff $R(p)$ as a function of p is,

$$\begin{aligned} &= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4}f && p \leq \frac{f}{c} \\ &= -k + \left(\frac{2-\beta^2}{4}\right)f && p \geq \frac{f}{c} \\ R'(p) &= c - \frac{pc^2}{f} && p \leq \frac{f}{c} \\ &= c\left(1 - \frac{pc}{f}\right) \\ &\geq 0 \iff \frac{pc}{f} \leq 1 \text{ which is always true } \forall\, p \leq \frac{f}{c} \end{aligned}$$

Thus, $R(p)$ is an increasing function of p within the range $[0, \frac{f}{c}]$. This suggests that for a given combination of (f, β, c, k) as p – the probability of attack – increases, the preference for communal regime increases. Figure B3 shows the relative payoffs as a function of p.[9]

[9]The plots assume $f = 0.65$ and, as before, $\beta = 0.25$, $c = 3$, and $k = 0.2$.

Figure B3: Payoff of Communal Relative to Private Land Rights
as a Function of Probability of Attack p



Prediction 3: Inequality is lower in the communal regime

We define inequality of payoffs in a regime $IE_r = \max(u_{ir}) - \min(u_{ir})$ where u_{ir} is the payoff of individual i of type e_i in regime r.

For individual rights, $IE_i = c - (c - pc) = pc$.

For communal rights, $IE_g = (c - k) - (c - \frac{f\beta}{2} - k) = \frac{\beta f}{2}$

Our previous assumption that $\forall f \in [0, 1]$ $\beta \leq \frac{2pc}{f} \implies pc \geq \frac{\beta f}{2}$. This means that the communal regime reduces inequality by reducing the spread of possible payoffs.

B.4. Risk-dominant equilibrium choice as the efficient equilibrium

We briefly discuss why the risk-dominant equilibrium choice corresponds to the efficient equilibrium choice for group monitoring (where individuals with the lowest monitoring costs up to β perform the monitoring).

Consider a two player game between types e_1 and e_2 such that both belong to either Group I or II – their monitoring costs are low enough so that they could contribute to group-monitoring. Assume β is such that only one individual is sufficient for group-monitoring success. The below two-player game has payoffs similar to our model. $(a_1, a_2) = (1, 0)$ and $(0, 1)$ are the two Nash equilibria. However, can we motivate the choice of one over the other?

Type e_2

		$a_2 = 1$	$a_2 = 0$
Type e_1	$a_1 = 0$	$c \quad , \quad c - \frac{fe_2}{2}$	$c - pc \quad , \quad c - pc$
	$a_1 = 1$	$c - \frac{fe_1}{2} \quad , \quad c - \frac{fe_2}{2}$	$c - \frac{fe_1}{2} \quad , \quad c$

Following the formal definition of risk dominance, in a two player game between types e_1, e_2 with $e_2 > e_1$, $(1, 0) \succ (0, 1)$ where $\succ$ stands for "risk-dominates". This is because $(1, 0) \succ (0, 1)$ if and only if the product of payoff deviations from $(1, 0)$ is greater than the product of payoff deviations from $(0,1)$:

$$\left(-pc+\frac{fe_1}{2}\right)\left(-\frac{fe_2}{2}\right) > \left(-pc+\frac{fe_2}{2}\right)\left(-\frac{fe_1}{2}\right)$$
$$\frac{pcfe_2}{2} > \frac{pcfe_1}{2}$$
$$e_2 > e_1$$

If we extrapolate this logic to a continuum of types, every equilibrium where a lower type chooses $a_i = 1$ risk dominates the sister equilibrium where a higher type chooses $a_i = 1$ instead. Thus, it is plausible that in equilibrium, the lowest types in the set $[0, \beta]$ will choose $a_i = 1$ and the rest will free-ride to result in the most efficient Nash equilibrium.

Appendix C. Additional Tables and Figures

C.1. Additional Results: Robustness of Ethnographic Results

Table C1: Effect of Fallow Requirement on Intensity of Agricultural Production

	Dependent Variable: *Intensity of Agriculture [1-6]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement	-0.052^{**}	-0.058^{***}	-0.035	-0.039	-0.038	-0.029
	(0.023)	(0.020)	(0.024)	(0.025)	(0.025)	(0.025)
	[0.023]	[0.019]	[0.023]	[0.024]	[0.024]	[0.022]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	3.47	3.47	3.47	3.47	3.47	3.46
Adjusted R2	0.029	0.199	0.201	0.193	0.206	0.487
Beta Coef.	-0.186	-0.206	-0.126	-0.140	-0.134	-0.100
Observations	167	167	167	167	167	154
	Panel B: Augmented Sample					
Fallow Requirement	-0.029^{*}	-0.045^{***}	-0.032^{**}	-0.025	-0.027^{*}	-0.016
	(0.016)	(0.014)	(0.015)	(0.015)	(0.016)	(0.013)
	[0.017]	[0.014]	[0.015]	[0.015]	[0.015]	[0.013]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	3.35	3.35	3.35	3.35	3.35	3.44
Adjusted R2	0.006	0.241	0.266	0.272	0.295	0.562
Beta Coef.	-0.095	-0.148	-0.105	-0.082	-0.088	-0.057
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses. The dependent variable *Intensity of Agriculture* is a 1 to 6 categorical variable, with higher values related to more intensive agricultural production. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C2: Effect of Fallow Requirements on Jurisdictional Hierarchy

	Dependent Variable: *Extent of Jurisdictional Hierarchy [1-5]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Societies					
Fallow Requirement	−0.026	−0.021	0.008	0.014	0.019	0.013
	(0.016)	(0.013)	(0.016)	(0.017)	(0.017)	(0.016)
	[0.016]	[0.013]	[0.015]	[0.016]	[0.016]	[0.015]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.14	2.14	2.14	2.14	2.14	2.14
Adjusted R2	0.009	0.247	0.276	0.288	0.290	0.440
Beta Coef.	-0.124	-0.097	0.038	0.066	0.091	0.062
Observations	165	165	165	165	165	152
	Panel B: Augmented Sample					
Fallow Requirement	−0.007	−0.009	0.008	0.016	0.015	0.016
	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)
	[0.011]	[0.010]	[0.011]	[0.011]	[0.011]	[0.010]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	1.99	1.99	1.99	1.99	1.99	2.03
Adjusted R2	-0.002	0.258	0.279	0.293	0.311	0.439
Beta Coef.	-0.034	-0.039	0.039	0.075	0.068	0.076
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A or the Ethnographic Atlas (EA) in Panel B. Robust standard errors in parentheses. The dependent variable *Extent of Jurisdictional Hierarchy* measures the degree of jurisdictional hierarchy beyond the local level, ranging from 1=no levels, to 5=four levels. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C3: Effect of Fallow Requirement on Contemporary Fallowing Practices: Ordered Logit

	Dependent Variable: *Contemporary Fallowing Practices [0-2]*				
	(1)	(2)	(3)	(4)	(5)
Fallow Requirement	0.033*	0.031	0.032*	0.043**	0.041**
	(0.018)	(0.020)	(0.019)	(0.019)	(0.019)
Country FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	0.72	0.72	0.72	0.72	0.72
Pseudo R2	0.031	0.033	0.036	0.039	0.040
Observations	10,744	10,744	10,744	10,744	10,744
Clusters	121	121	121	121	121

Notes: The unit of observation is a plot in the *An agricultural survey for more than 9,500 African households* survey (Waha et al. 2016). Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses. Estimated using ordered logistic regression. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C4: Effect of Fallow Requirement on Communal Land Rights: Binary Measure

	Dependent Variable: *Communality of Land Rights [0/1]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement	0.015**	0.014**	0.016**	0.017**	0.017**	0.018**
	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
	[0.006]	[0.007]	[0.006]	[0.006]	[0.006]	[0.006]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	0.80	0.80	0.80	0.80	0.80	0.79
Adjusted R2	0.038	0.048	0.056	0.040	0.152	0.193
Beta Coef.	0.221	0.212	0.236	0.252	0.250	0.263
Observations	88	88	88	88	88	86
	Panel B: Augmented Sample					
Fallow Requirement	0.012***	0.011***	0.013***	0.012***	0.013***	0.012***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	0.87	0.87	0.87	0.87	0.87	0.87
Adjusted R2	0.038	0.157	0.179	0.181	0.187	0.196
Beta Coef.	0.202	0.185	0.223	0.205	0.217	0.210
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Communality of Land Rights* is an indicator variable equal to 1 if a society had either partial or full communal land rights, and 0 otherwise. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C5: Effect of Fallow Requirement on Communal Land Rights: Ordered Logit

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement	0.127***	0.112**	0.095**	0.101**	0.116*	0.115**
	(0.046)	(0.050)	(0.044)	(0.047)	(0.064)	(0.057)
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Pseudo R2	0.063	0.097	0.147	0.151	0.248	0.334
Observations	88	88	88	88	88	86
	Panel B: Augmented Sample					
Fallow Requirement	0.048**	0.075***	0.090***	0.091***	0.092***	0.078***
	(0.021)	(0.028)	(0.033)	(0.034)	(0.035)	(0.030)
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.41	2.41	2.41	2.41	2.41	2.40
Pseudo R2	0.010	0.127	0.150	0.155	0.167	0.213
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. Estimated using ordered logistic regression. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C6: Effect of Fallow Requirement on Communal Land Rights:
Pre-Columbian Exchange Measure of Fallow Requirements

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement (Pre-1500 Crops)	0.043***	0.036**	0.036**	0.036**	0.039**	0.037**
	(0.014)	(0.015)	(0.015)	(0.014)	(0.017)	(0.016)
	[0.014]	[0.014]	[0.013]	[0.013]	[0.014]	[0.014]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.31	2.31	2.31	2.31	2.31	2.31
Adjusted R2	0.089	0.106	0.112	0.099	0.170	0.246
Beta Coef.	0.316	0.266	0.261	0.263	0.289	0.272
Observations	85	85	85	85	85	83
	Panel B: Augmented Sample					
Fallow Requirement (Pre-1500 Crops)	0.021**	0.019**	0.017*	0.018*	0.017*	0.014
	(0.008)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.38	2.38	2.38	2.38	2.38	2.39
Adjusted R2	0.024	0.107	0.117	0.111	0.102	0.165
Beta Coef.	0.169	0.149	0.138	0.143	0.133	0.109
Observations	226	226	226	226	226	218

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C7: Effect of Fallow Requirement on Communal Land Rights:
Fallow Requirement Using Average of Top-3 Max CSI Crops

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement (Average Top-3 Max CSI Crops)	0.043***	0.039***	0.036***	0.038***	0.037**	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)	(0.014)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.012]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.116	0.201	0.267
Beta Coef.	0.330	0.296	0.269	0.287	0.277	0.266
Observations	88	88	88	88	88	86
	Panel B: Augmented Sample					
Fallow Requirement (Average Top-3 Max CSI Crops)	0.020***	0.019**	0.019**	0.019**	0.018**	0.016*
	(0.008)	(0.007)	(0.008)	(0.009)	(0.009)	(0.009)
	[0.008]	[0.007]	[0.008]	[0.008]	[0.008]	[0.009]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.38	2.38	2.38	2.38	2.38	2.39
Adjusted R2	0.024	0.099	0.112	0.105	0.098	0.148
Beta Coef.	0.169	0.157	0.157	0.162	0.155	0.138
Observations	229	229	229	229	229	221

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C8: Effect of Fallow Requirement & Land Suitability on Communal Land Rights

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Sample					
Fallow Requirement	0.043***	0.039***	0.035***	0.038***	0.036**	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)	(0.015)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.013]
Land Suitability			−0.158	−0.119	0.108	0.280
			(0.346)	(0.354)	(0.361)	(0.343)
			[0.317]	[0.320]	[0.315]	[0.291]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.115	0.201	0.267
Beta Coef.	0.329	0.296	0.269	0.286	0.276	0.266
Observations	88	88	88	88	88	86
	Panel B: Augmented Sample					
Fallow Requirement	0.020***	0.021***	0.025***	0.025***	0.026***	0.024***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Land Suitability			0.011	0.030	−0.095	−0.057
			(0.147)	(0.147)	(0.184)	(0.177)
			[0.144]	[0.143]	[0.177]	[0.169]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.41	2.41	2.41	2.41	2.41	2.40
Adjusted R2	0.022	0.209	0.227	0.229	0.224	0.273
Beta Coef.	0.158	0.174	0.204	0.202	0.209	0.193
Observations	316	316	316	316	316	305

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A and a society in the augmented sample in Panel B. Robust standard errors in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C9: Fallow Requirement and Influence of Traditional Leaders

	Dependent Variable: *Influence of Traditional Leaders in:*			
	Allocating Land [0-3]		*Governing Community [0-3]*	
	(1)	(2)	(3)	(4)
Fallow Requirement	0.012***	0.011***	0.010***	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)
	[0.004]	[0.004]	[0.003]	[0.003]
Country FEs	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
Geography Controls	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y
Outcome Mean	2.65	2.65	2.83	2.83
Adjusted R2	0.120	0.120	0.111	0.111
Beta Coef.	0.050	0.048	0.044	0.046
Observations	39,044	39,044	39,156	39,156
Clusters	630	630	630	630

Notes: The unit of observation is a respondent in the Afrobarometer Surveys round 8. Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. All regressions control for a respondent's age, age squared and gender. Enumeration areas' latitude and longitude included in every specification. *Influence of Traditional Leaders in Allocating Land* and *Influence of Traditional Leaders in Governing Community* are 0 to 3 categorical variables where 0 = none, 1 = A small amount, 2 = Some, and 3 = A lot. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C10: Fallow Requirements and Land Management: Micro Evidence from Congo

	Dependent Variable:			
	Leader-level		*Villager-level*	
	Fallow length (years)	*Share with land title* [0–4]	*Chief resp: land alloc.* [0–2]	*Chief resp: land conflicts* [0–2]
	(1)	(2)	(3)	(4)
Fallow Requirements	0.068**	-0.052***	0.015*	0.033***
	(0.033)	(0.018)	(0.008)	(0.009)
	[0.031]	[0.027]	[0.013]	[0.017]
Individual Controls	Y	Y	Y	Y
Village Controls	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y
Outcome Mean	3.484	0.562	0.279	0.837
Adjusted R2	0.036	0.155	0.126	0.080
Beta Coef.	0.118	-0.169	0.059	0.122
Observations	545	539	3,547	3,570
Villages	293	298	301	301

Notes: Data from 302 villages in Gemena, Kungu, and Lisala territories of the DRC (2016–2017). Robust standard errors clustered at the village level in parentheses, and Conley (1999) standard errors calculated using a 50 km cut-off window are presented in brackets. The treatment variable *Fallow Requirements* is the ecologically determined length of fallow. *Individual Controls*: age and age squared for leader-level outcomes (columns 1–2); gender, age, and age squared for peasant-level outcomes (columns 3–4). *Village Controls*: land suitability, mean precipitation, log village size (number of households), elevation, malaria ecology, TSI, distance to nearest river (km), and share of peasants who are farmers. *Crop FEs*: fixed effects for the village's modal crop among peasants. *Fallow length* is the reported length of fallow in years. *Share with land title*: 0 = none, 1 = few, 2 = about half, 3 = most, 4 = all. *Chief responsibility*: 0 = not responsible, 1 = shared responsibility, 2 = primarily responsible. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C11: Fallow Requirements and Land Access: Micro Evidence from Congo

	Dependent Variable:		
	Villager-level		
	Number of plots	*Ln(plot size, hectares)*	*Plot distance (km)*
	(1)	(2)	(3)
Fallow Requirements	0.225***	-0.047**	0.052
	(0.044)	(0.021)	(0.046)
	[0.065]	[0.023]	[0.042]
Individual Controls	Y	Y	Y
Village Controls	Y	Y	Y
Crop FEs	Y	Y	Y
Outcome Mean	4.081	0.614	3.747
Adjusted R2	0.044	0.050	0.049
Beta Coef.	0.139	-0.053	0.033
Observations	3,404	2,847	3,297
Villages	301	298	301

Notes: Data from 302 villages in Gemena, Kungu, and Lisala territories of the DRC (2016–2017). Robust standard errors clustered at the village level in parentheses, and Conley (1999) standard errors calculated using a 50 km cut-off window are presented in brackets. The treatment variable *Fallow Requirements* is the ecologically determined length of fallow. *Individual Controls*: gender, age, and age^2. *Village Controls*: land suitability, mean precipitation, log village size (number of households), elevation, malaria ecology, the tsetse fly suitability index (TSI), distance to nearest river (km), and average share of farmers in the village. *Crop FEs*: fixed effects for the village's modal crop among peasants. *Number of plots* is the count of plots cultivated by the peasant. *Ln(plot size, hectares)* is the natural log of plot size in hectares; plot size is harmonized from original reporting units (meters squared, ares, or hectares) and winsorized at the 99th percentile. *Plot distance* is the distance from the respondent's home to their plot in kilometers, winsorized at the 99th percentile. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.2. Additional Results: World Bank Projects

Table C12: Effect of Fallow Requirements on World Bank Project Selection

	Dependent Variable:			
	Any Project (0/1)		*Rated Project (0/1)*	
	(1)	(2)	(3)	(4)
Fallow Requirement	−0.012	−0.012	−0.000	−0.000
	(0.014)	(0.015)	(0.008)	(0.008)
Continent FEs	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y
Project Year FEs	N	N	Y	Y
Geography Controls	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y
Outcome Mean	0.32	0.32	0.57	0.57
Adjusted R2	0.105	0.109	0.703	0.703
Beta Coef.	-0.025	-0.024	-0.000	-0.000
Observations	6,871	6,871	52,175	52,175
Clusters	216	216	133	133

Notes: The unit of observation is an ethnologue group in columns 1 and 2, and a world bank project location by ethnologue group in columns 5 and 6. Standard errors clustered by ethnologue group in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable in columns 1 and 2, *Any Project*, is an indicator variable equal to 1 if the ethnologue group had at least one world bank project in the Aid Data sample. The dependent variable in columns 3 and 4, *Rated Project*, is an indicator variable equal to 1 if a world bank project has an outcome rating. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, an index of settlement density, and an index of political development. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C13: Effect of Fallow Requirement on World Bank Project Success:
Rating Sub-Components

	Dependent Variable: World Bank Project Rating [1-6]									
	Bank Quality at Entry		*Bank Quality of Supervision*		*Overall Bank Quality*		*Local Implementing Agency*		*Government*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Panel A: Land Administration Projects									
Fallow Requirement	-0.015	0.020	-0.200	-0.235	-0.158	-0.155	-0.291^{*}	-0.330^{*}	-0.418^{***}	-0.441^{***}
× Land Admin. Project	(0.097)	(0.091)	(0.147)	(0.148)	(0.118)	(0.122)	(0.174)	(0.172)	(0.128)	(0.122)
Continent FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Project Sector FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Project Year FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geography Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ethnographic Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Country FEs	N	Y	N	Y	N	Y	N	Y	N	Y
Outcome Mean	4.21	4.21	4.21	4.21	4.20	4.20	4.21	4.21	4.20	4.20
Adjusted R2	0.173	0.273	0.257	0.327	0.243	0.318	0.155	0.255	0.145	0.257
Beta Coef.	-0.002	0.002	-0.024	-0.028	-0.019	-0.019	-0.035	-0.040	-0.051	-0.053
Observations	29,191	29,190	29,123	29,122	29,466	29,465	29,046	29,045	28,636	28,635
Clusters	1,652	1,651	1,651	1,650	1,653	1,652	1,651	1,650	1,636	1,635

Notes: The unit of observation is a project location-ethnologue pair. Standard errors are clustered at the ethnologue level and presented in parentheses. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Land Administration Project* is an indicator variable equal to 1 if the project title or sector includes keywords related to land administration and 0 otherwise. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C14: Effect of Fallow Requirement on World Bank Project Success:
Effects by Early vs. Later Projects

	Dependent Variable: World Bank Project Rating [1-6]	
	Pre-2005	*Post-2005*
	(1)	(2)
Fallow Requirement	-0.568^{***}	0.057
× Land Admin. Project	(0.145)	(0.106)
Project Sector FEs	Y	Y
Project Year FEs	Y	Y
Geography Controls	Y	Y
Disease Controls	Y	Y
Crop FEs	Y	Y
Ethnographic Controls	Y	Y
Country FEs	Y	Y
Outcome Mean	4.24	4.06
Adjusted R2	0.292	0.288
Beta Coef.	-0.070	0.006
Observations	23,342	6,084
Clusters	1,537	682

Notes: The unit of observation is a project location-ethnologue pair. Standard errors are clustered at the ethnologue level and presented in parentheses. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Land Administration Project* is an indicator variable equal to 1 if the project title or sector includes keywords related to land administration and 0 otherwise. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C15: Effect of Fallow Requirement on World Bank Project Success
Country-Level Fallow Requirement

	Dependent Variable: World Bank Project Rating [1-6]					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement × *Land Admin. Project*	-0.741^{***} (0.219) [0.086]	-0.762^{***} (0.216) [0.085]	-0.716^{***} (0.228) [0.085]	-0.698^{***} (0.222) [0.084]	-0.663^{***} (0.214) [0.081]	-0.693^{***} (0.211) [0.088]
Continent FEs	N	Y	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y	Y	Y
Project Year FEs	N	N	Y	Y	Y	Y
Geography Controls	N	N	N	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Country FEs	N	N	N	N	N	Y
Outcome Mean	4.18	4.18	4.18	4.18	4.18	4.18
Adjusted R2	0.023	0.044	0.139	0.151	0.159	0.268
Beta Coef.	-0.082	-0.085	-0.080	-0.078	-0.074	-0.077
Observations	31,706	31,706	31,650	31,650	31,650	31,650
Clusters	124	124	124	124	124	124

Notes: The unit of observation is a project-country pair. Standard errors are clustered at the country level and presented in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Fallowing Requirement* is the country-level population-weighted measure of a country's fallowing requirement. *Land Administration Project* is an indicator variable equal to 1 if the project title or sector includes keywords related to land administration and 0 otherwise. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.3. *Additional Results: Inequality and Conflict*

Table C16: Effect of Fallow Requirement on Night Light Density

	Dependent Variable: *Log(Night Light Density + 1)*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.001 (0.002) [0.002]	0.003 (0.002) [0.002]	0.003 (0.002) [0.002]	0.003 (0.002) [0.002]	0.002 (0.002) [0.002]	0.002 (0.002) [0.002]
Country FEs	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Population Controls	N	N	N	N	N	Y
Outcome Mean	0.22	0.22	0.22	0.22	0.22	0.22
Adjusted R2	0.318	0.331	0.331	0.333	0.354	0.355
Beta Coef.	0.007	0.028	0.029	0.029	0.023	0.023
Observations	3,825	3,825	3,825	3,825	3,734	3,734
Clusters	143	143	143	143	142	142

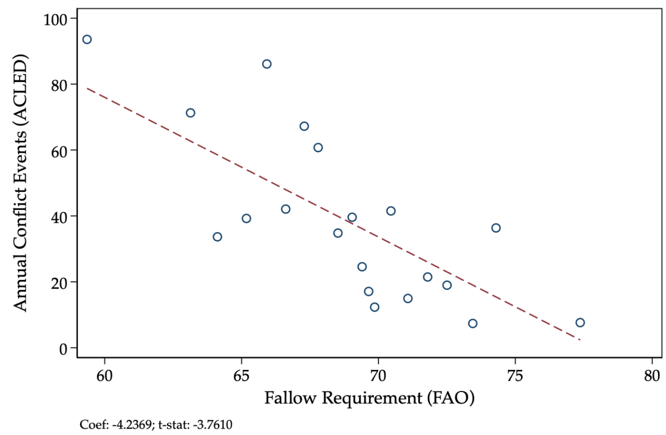
Notes: The unit of observation is an ethnologue group. Standard errors clustered by ethnologue group in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Log(Night Light Density + 1)* is defined as the log of the mean night light intensity plus one in the VIIRS data per ethnologue group in 2019 using nighttime lights data from Elvidge et al. (2021). *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. *Population Controls* includes log population density for each group. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C17: Effect of Fallow Requirement on Inequality and Wealth Score: Demographic and Health Surveys (DHS)

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable:				
	Panel A: Dep. Var.: Standard Deviation of Wealth Scores				
Fallow Requirement	-0.314^{**}	-0.411^{***}	-0.411^{***}	-0.401^{***}	-0.398^{***}
	(0.128)	(0.124)	(0.117)	(0.114)	(0.122)
	[0.142]	[0.253]	[0.246]	[0.242]	[0.240]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	62.87	62.87	62.87	62.87	63.46
Outcome SD	76.88	77.04	77.04	77.04	79.43
Adjusted R2	0.615	0.625	0.625	0.625	0.627
Beta Coef.	-0.018	-0.023	-0.023	-0.023	-0.022
Observations	66,453	66,169	66,169	66,169	61,775
Clusters	114	114	114	114	114
	Panel B: Inter-Quartile Range of Wealth Scores				
Fallow Requirement	-0.465^{**}	-0.544^{***}	-0.553^{***}	-0.545^{***}	-0.509^{***}
	(0.208)	(0.206)	(0.190)	(0.190)	(0.189)
	[0.199]	[0.336]	[0.327]	[0.323]	[0.320]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	78.26	78.23	78.23	78.23	78.93
Outcome SD	101.42	101.61	101.61	101.61	104.63
Adjusted R2	0.527	0.539	0.539	0.539	0.541
Beta Coef.	-0.020	-0.024	-0.024	-0.024	-0.021
Observations	66,451	66,167	66,167	66,167	61,773
Clusters	114	114	114	114	114
	Panel C: Average Wealth Score				
Fallow Requirement	0.206	-1.243^{*}	-1.339^{*}	-1.018	-0.641
	(0.707)	(0.712)	(0.724)	(0.645)	(0.719)
	[0.843]	[0.800]	[0.775]	[0.760]	[0.749]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	-2.57	-2.80	-2.80	-2.80	-0.86
Outcome SD	165.51	165.79	165.79	165.79	170.17
Adjusted R2	0.017	0.219	0.220	0.222	0.218
Beta Coef.	0.006	-0.033	-0.036	-0.027	-0.016
Observations	66,453	66,169	66,169	66,169	61,775
Clusters	114	114	114	114	114

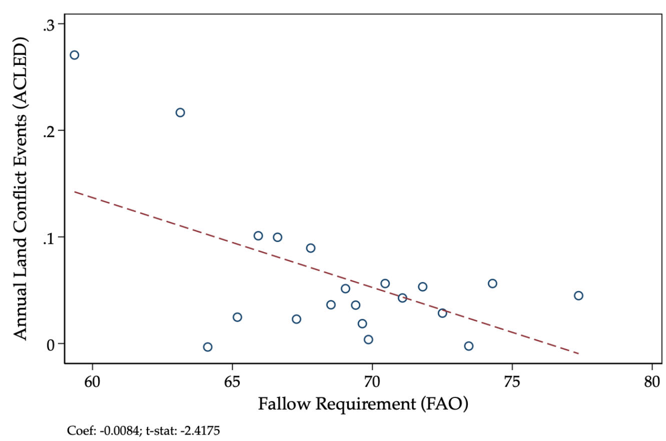
Notes: The unit of observation is a DHS cluster. Standard errors in parentheses are two-way clustered by country-survey wave and ethnologue group. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. In Panel A, the outcome variable is the standard deviation of the DHS wealth score. In Panel B, the outcome variable is the inter-quartile range of the DHS wealth score. In Panel C, the outcome variable is the average DHS wealth score. All regressions control for cluster size and rural-urban status. *Geography Controls* include cluster longitude, cluster latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric-suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each DHS cluster. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure C1: Fallowing Requirements & Conflict: All Conflicts



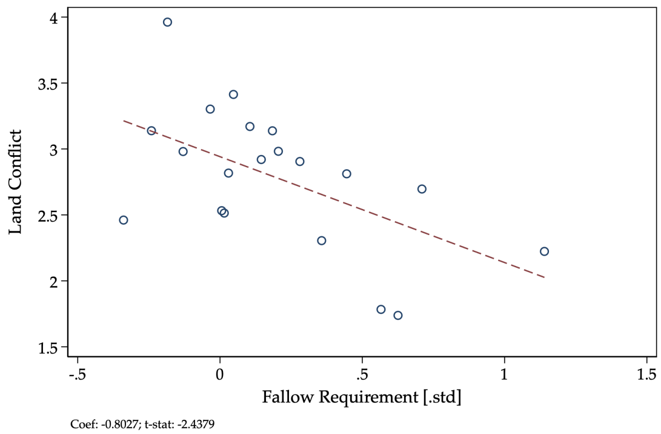
Notes: The figure presents a binscatter between the fallow requirement and the annual number of conflicts in the ACLED data. The unit of observation is a ethnologue group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue group level.

Figure C2: Fallowing Requirements & Conflict: Land-Related Conflicts



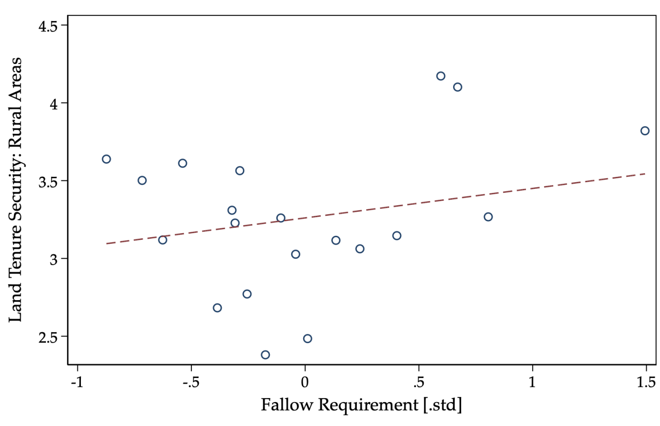
Notes: The figure presents a binscatter between the fallowing requirement and the annual number of land-related conflict events in the ACLED data. The unit of observation is an ethnologue group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue group level.

Figure C3: Fallowing Requirements & Land-Related Conflict: IPD Data



Notes: The figure presents a binscatter between the fallow requirements and the severity of land-related conflict in rural areas in the IPD data. The unit of observation is a country. Land conflict is a 0 to 4 categorical variable, where 0 = No land-related conflict in rural areas, and 4 = Serious land-related conflict in rural areas. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the country level.

Figure C4: Fallow Requirements & Land Security: Institutional Profiles Dataset



Notes: The figure presents a binscatter between the fallow requirement and the extent of land tenure security in rural areas in the Institutional Profiles Database. This variable is a 0 to 4 categorical variable ranging from less to more secure land tenure, where 0 = very high land tenure insecurity, 1 = high insecurity, 2 = moderate insecurity, 3 = low insecurity, 4 = Very low insecurity. The unit of observation is a country. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-right of each figure presents the estimated bivariate coefficient and t-statistic. Robust standard errors are in parentheses.